THE PRODUCTION AND INITIAL TESTING OF THE MODULE "THE WINTER ENVIRONMENT" FOR USE IN NEWFOUNDLAND ELEMENTARY SCHOOLS

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THE PRODUCTION AND INITIAL TESTING OF THE MODULE "THE WINTER ENVIRONMENT" FOR USE IN NEWFOUNDLAND ELEMENTARY SCHOOLS

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ABSTRACT

In late 1973, in order to fill the needs for a program concerned with proper knowledge of the local environment among elementary school children in the province, a module in environmental education was developed for use with Grade V and VI classes in Newfoundland elementary schools. The module was developed using a modified edition of the curriculum development model originally produced by Taba (1962), and incorporating the suggestions of Rioux (1973) in his report on the status of environmental education in Canada.

The first edition of the module was field-tested in one school in February and March of 1974 with two Grade VI classes. As a result of this first field trial, the module was revised and rewritten. In March, April and May of 1974, the revised module was again field-tested in two schools, one in an urban area and one in a rural area, using one Grade V and one Grade VI class in each school.

The usefulness and effectiveness of the module was judged by a series of evaluative instruments especially developed for use with the module. The instruments included a cognitive pre- and post-test and an attitude to the environment test for students, as well as a course opinion questionnaire. Throughout the teaching of the module, teachers were interviewed about each individual lesson, using the teacher interview schedule, and, at the end of the module, the teachers were asked to fill in a course opinion questionnaire.

The results of all these tests and questionnaires were analysed

and indicated that the module was successful with the small sample of students used, and that the teachers were also enthusiastic about it. The students not only liked the module but considered they learned a lot from it, while at the same time enjoying themselves.

It is recommended that the module be revised to take account of teachers' suggestions, and that this new version of the module be field-tested in a larger number of schools throughout the province.

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CHAPTER I

INTRODUCTION

A. THE PURPOSE OF THE STUDY

The purpose of this study was to develop a curriculum module in environmental education for use in Newfoundland Elementary Schools, using as a guideline a curriculum development model developed by Taba (1962). Present environmental education curricula in the U.S.A., as well as Canada, were examined to see if any would be of direct or indirect use to the study. The module was then developed and tried out in various elementary schools in the St. John's area, with both Grade V and Grade VI classes, and its success evaluated. The module is intended for use as a replacement for, or an addition to, the regular school science curriculum.

B. THE JUSTIFICATION FOR THE STUDY

The need for all people to know more about their environment, and man's place in it, has been increasingly stressed ever since Rachel Carson's book SILENT SPRING was published in 1962.

In 1972 the United Nations sponsored the "Conference on the Human Environment"[1] in Stockholm, Sweden. The multi-national conference stated many environmental principles, one of which referred

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1. See "Conference on the Human Environment", Environment Canada, Ottawa, 1972, p.20.

to the need for environmental education. Principle 19 stated: "Education in environmental matters for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension." The United Nations, then, stated that all countries should be involved with the environmental education of all their citizens.

Later on, in 1973, Environment Canada retained J. C. Rioux to report on environmental education in Canadian schools. Rioux stated in his report, that Canada was not doing enough to encourage children to learn how the natural world works and to understand the nature of environmental threats. As a result, he suggested various steps which could be taken to develop high quality environmental programs across the country. In his research the author found that ecology is not being taught across the country, although a few provinces (but not Newfoundland) offer ecology-oriented natural science courses at the senior secondary level. (p. 33)

Rioux goes on to suggest various means by which environmental education could be introduced into both the elementary and high schools.

Previously, in 1970, the I.U.C.N. (International Union for the Conservation of Native and Natural Resources) and UNESCO had co-operated in sponsoring a World Meeting on Environmental Education at the Foresta Institute in Nevada. At this meeting, the fourteen nations

represented (including Canada) recommended strongly the inclusion of environmental education in the school curriculum and the need for greater international co-operation. As a result, a North American committee of Americans and Canadians was formed and subsequently formulated guidelines for curriculum design, but these never received Canadian support. (Rioux, p. 18)

In Newfoundland the first call for environmental education followed the incorporation of the Working Group on the Environment in 1970. Among this group's projects was a drive "to promote the adoption of an ecologically-oriented biology textbook in the high schools".[2]

Subsequently, in 1971 a Short Course on Environmental Education for serving teachers was sponsored jointly by the NTA, Memorial University, the Denominational Education Committees, and the Provincial Department of Education. The foreword of the report[3] of the conference stated, "Because there appeared to be a certain lag in the development of public awareness of environmental problems in the province.... In order to develop a better informed public, it was apparent that the schools should be the prime movers in this new awareness." The conference, then, established the need for environmental programs in the schools.

Later on in 1973 the Natural Resources Workshop of the

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2. The Evening Telegram, "Pollution Group to Incorporate", 3rd July, 1970, p. 40.

3. "Synopsis of the Short Course on Environmental Education", 1971, NTA, pp. 16.

Citizens' Rights and Freedoms Conference, held in St. John's, not only recommended that

> "(7) Newfoundland ecology be taught in high school science courses"; but also that
>
> "(6) An ecological programme should be implemented in the school curriculum in the early school years."[4]

In the same year, a submission to the Minister of Tourism of the Provincial Government[5] included the following recommendation (#15): "In order to help preserve our environment, an extensive education programme must be instituted to communicate to our population, the importance of preserving our present clean environment, together with its animals and plants for all to enjoy. To be completely effective, the campaign should not be aimed only at adults, but mainly at children of school age, by use of environmental education programmes, as well as at their teachers. Kits should be prepared on environmental education with the help of the Faculty of Education of Memorial University and the N.T.A. for use in our schools, in the hope that tomorrow's citizens will be more environmentally aware than today's adults."

The need for environmental education units aimed at elementary school students was then established.

C. PROBLEMS TO BE INVESTIGATED

When the curriculum module had been developed it was

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4 Report of the "Citizens' Rights and Freedoms Conference", 1973, Recommendations, p. 11.

5 Submission to the Minister of Tourism from the Working Group on Environment, 1973, 7 pp.

field tested by the author and one teacher in one elementary school in St. John's, and initial revisions were made when necessary. The revised module was then tested in several other elementary schools in the St. John's area. The following problems were investigated:

1. Can an environmentally-oriented module be developed which can be used successfully in Newfoundland elementary schools?

2. To what extent will the module produce an increase in students' cognitive knowledge of the local environment?

3. To what extent will the module cause a measurable change in the attitude of students to their environment?

4. To what extent is the module suitable in its final form for both Grade V and VI classes? Should it only be used at one or other of the grade levels, or does it need to be rewritten before this is possible?

5. Is it possible to provide a written teacher's guide which any elementary school teacher can use, regardless of educational qualifications?

6. To what extent do the teachers and students consider the module to be enjoyable, effective and useful?

D. SCOPE AND DELIMITATIONS OF STUDY

Rioux (op. cit.) in his report on environmental education in Canada had suggested various guidelines for the integration of environmental curricula into the elementary and high schools, some of which were followed in the production of the module.

He said, first of all, (p. 48) that there were at least three major strategies for getting environmental education into curricula:

1. National curricular reform (long term).

2. Integration of environmental education concepts into provincial curricula (intermediary), and

3. Development of special units of study by each province (short term).

As both the first and second strategies were beyond the scope of this investigation, strategy 3 is the one which was followed.

Rioux also stated that educators should agree on coverage of at least five fundamental concepts which he listed as follows:

(a) Living organisms depend on environments with certain characteristics.

(b) Life forms interact.

(c) Energy is the link between all organisms and their environment.

(d) Organisms respond to a continuous process of change in their environments.

(e) Finally, for each of these changes there are related consequences (e.g. a species adaptation or extinction). (p. 47).

As (a) was the most fundamental of the concepts listed, this was the one which formed the major framework of the module.

Rioux stressed the importance of student activities while investigating concepts, on page 51 of the report. "The important thing to remember is that the learner must perceive the interface between a concept and reality. Teachers can only hope to provide an initial conceptual framework which will allow for the richest possible learning experience, but the learner must actively reach out to learn. As the learner makes contact with the real world of people, things, and events he develops "self" concepts out of those described initially by the teacher. Hence activities in the "field" are crucial, in that they

provide the key integration and test of the fit between concept and reality." So Rioux stressed the importance of not only student activities during any environmental activity, but also of "field" experiences. He also stated (p. 50) that "reform of curriculum either nationally or with individual approaches in each province would include ... focussing on the local environment". As a result the module was based on student activities and some field experiences.

An important objective in the development of any environmental education curricula is to change the attitude of students to their environment, and it seemed reasonable to assume that this would be greatly enhanced by student activities. Rioux stated, in fact, on p. 52, that "research should be conducted on student attitudes towards the environment to provide baseline data for a retest in 5 years", implying, at least, that any curriculum should change student attitudes; even if not explicitly stating this in his report.

Many present environmental modules are very sophisticated and require expensive equipment and materials for their operation, but Rioux said (p. 34) that "a properly trained environmental educator needs only the immediate schoolyard environment, the most minimum of classroom laboratory facilities and makeshift equipment in order to teach young elementary school learners about ecological principles and environmental concerns". This module incorporates these minimal suggestions of Rioux's.

Finally the impact of such an environmental education curriculum had to be measured to see (a) if it is successful, and

(b) whether the original need for the curriculum is still there. Rioux suggested (p. 61) that "a baseline in-depth study of knowledge and awareness of environmental matters should be conducted among elementary and secondary school students to permit progressive evaluation of the impact of the various environmental education programs currently underway and those anticipated".

Rioux did not suggest any model or guidelines which should be followed in the development of the module, so a model was chosen from other sources. (See Chapter III).

The module developed, then, included Rioux's suggestions and was developed according to a curriculum development model.

Because of the limitations of time during which research could be carried out, the written course consisted of approximately fourteen class sessions. The module was aimed primarily at Grade V and VI classes. As the time of research was winter, it was inevitable that the module developed would be concerned with the winter environment, and a terrestrial one at that, as ponds, rivers and seashores are most likely to be frozen over at that time of year. The module was based on student activities in a classroom, as elementary schools have no laboratories, and field trips in the schoolgrounds, and used only minimal equipment which is normally found in elementary schools. Because of the lack of funds of both schools and schoolboards, the module's cost had to be small, and any materials used had to be cheap and readily available. To test the original objectives of the module, both cognitive (knowledge) and affective (attitude) tests were included.

Presently developed modules were checked to see if they would be applicable for use in Newfoundland elementary schools, but, as Newfoundland is an island and has unique climatic characteristics, as well as unique animals and ecological relationships, it was not possible to use, intact, any complete existing modules.

E. LIMITATIONS OF THE STUDY

The limitations of the study were the following:

1. Library research (including an ERIC Computer Search) failed to reveal the presence of affective domain tests which could reliably measure the attitude of elementary school students towards their environment. Therefore student attitude had to be measured by anecdotal records and instruments which were not refined or rigorously tested for reliability and validity.
2. The module was only field tested in a few schools in the St. John's area, which were probably not typical of Newfoundland elementary schools in general. The results of the study, therefore, may not be immediately generalizable to all elementary schools in Newfoundland.
3. The cognitive instrument developed by the author as a pre-test and post-test to measure the increase in cognitive environmental knowledge due to the module, was not tested and refined in a rigorous manner for reliability and validity, although limited validity and

reliability tests showed it to be both reasonably valid and reliable.

4. The interview schedule which was drawn up to canvass teachers' attitudes and opinions regarding the course also lacked rigorous reliability and validity testing in the field.

F. DEFINITION OF TERMS

1. MODULE - "A self-contained and independent unit of instruction with a primary focus on a few well-defined objectives. The substance of a module consists of materials and instructions needed to accomplish these objectives. A module consists of the following components:

   1. A statement of purpose
   2. Desirable pre-requisite skills
   3. Instructional Objectives
   4. Diagnostic pre-test
   5. Implementers for the module (i.e. equipment and supply list)
   6. The Modular Program
   7. Related experiences
   8. Evaluative post-test
   9. Assessment of the module."

(MURRAY, Darryl L. in "The Components of a Module", pp. 5-8, in THE USE OF MODULES IN COLLEGE BIOLOGY TEACHING).

2. ENVIRONMENTAL EDUCATION - "Is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his bio-physical surroundings. Environmental education also entails practice in decision making and self-formulation of a code of behaviour about issues concerning environmental quality."

(Postulated by World Meeting on Environmental Education at Foresta Institute in Nevada, U.S.A., 1970, sponsored by I.U.C.N. and UNESCO and found in Rioux (p. 14).

(Environmental education is difficult to define and still get agreement on the definition. It is, however, not ecology, natural history, conservation education, or outdoor education, but involves all of these).

3. FORMATIVE EVALUATION - "Evaluation which takes place during the development of a curriculum, and is used to modify the curriculum before its final writing."

4. SUMMATIVE EVALUATION - "Evaluation which occurs after the use of the curriculum, and is used to judge its value and effectiveness."

CHAPTER II

LITERATURE REVIEW

A. ENVIRONMENTAL EDUCATION CURRICULA

An extensive search was made of existing environmental education curricula in both Canada and the U.S.A. to see if any of these curricula would be suitable for whole or partial adoption in Newfoundland.

The following criteria were used as guidelines for choosing curriculum materials which might be useful in Newfoundland:

(a) The material included should be directly applicable to the Newfoundland situation (i.e. climate, animals and plants).

(b) The cost of the module, necessary materials, trips and equipment should be minimal.

(c) Cognitive Domain (Bloom et al) objectives and test items should be included.

(d) Affective Domain (Krathwohl et al) objectives and test items should be present.

(e) The unit should be based on student activities.

(f) The unit should be suitable for Grade V and VI students.

(g) The unit should be relatively short (10-16 class periods).

(h) It should require no previous environmental background of the teachers.

Names and addresses of organizations involved with environmental education projects were obtained from the Eighth Report of the International Clearinghouse on Science and Mathematics Curricular

Developments 1972 and the Journal of Environmental Education (Volumes 1-4). Other organizations' names and addresses were obtained from teachers and the Curriculum Centre of the Education Library.

As a result, thirty-seven letters were sent requesting organizations to supply curriculum materials which they had produced. Twenty-five organizations complied with the request (see Appendix A), and information was gained from other sources regarding four other curricula.

None of the curriculum projects satisfied all of the eight requirements, as was expected. Of the twenty-nine curricula examined, only two were considered to have met a majority of the requirements, namely, PROJECT CLEAN (Shawnee Mission, Kansas), and the Environmental Education Demonstration Project of Topeka, also in Kansas. Neither satisfied the Newfoundland applicability requirement, but both included cognitive domain behavioural objectives and test items. Affective domain objectives were included but no means of stressing their development during the modules or evaluation were included. Both were more or less based on student activities (especially Topeka), and both projects had formulated a large number of environmental modules suitable for various grade levels and subject areas.

The PROJECT CLEAN modules were short (around five class periods), while the Topeka modules were far longer. Even though neither required teachers to have had previous environmental education backgrounds, both organizations had curriculum specialists to advise and help teachers doing the modules.

With regard to requirement (b), both were relatively inexpensive, the teachers' guides costing $2.00 or less, but both required several films which are not available in Newfoundland. The Topeka project also involved the use of a large amount of materials (most easily obtained) some of which (e.g. thermometers) are expensive to purchase in large numbers.

The Topeka project Teacher's Guide was, unfortunately, long because of its thickness and comprehensiveness, as it contained film reviews, readings and overhead transparency masters. It was felt that many teachers would not be willing to spare the time necessary to read all two hundred pages of such a guide before starting a month-long project. By comparison, the PROJECT CLEAN Teacher's Guides were more attractive in that they were shorter (less than twenty pages), and easier to follow and read. (The Topeka Guide is very difficult to follow as there is no introduction as to how to use it).

It was decided, therefore, to incorporate the ideas of the two projects into a Newfoundland environmental module.

Library research revealed a dearth of Canadian Projects, as already noted in Rioux (op. cit.). The latter, however, states in his report (p. 8) that the Canadian Wildlife Federation "has long advocated the teaching of ecology at elementary and secondary levels", and has just recently (1972) published the first of three books in a series on Canadian ecology entitled "Learning About Environment".[6]

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[6] HARRINGTON, Robert F. and Richard C. PASSMORE, 1972, CWF, Ottawa.

Even though it is aimed at intermediate and senior levels of the elementary school program, a reviewer felt that, at least in Newfoundland, this program would be more appropriately used in junior high and senior high schools. (COLLINS, M. A. J., N.T.A. Journal 64, 1, p. 22, 1972). The Teacher's Guide supplied factual information but did not involve student activities, and there were no behavioural objectives or test items. The only activities suggested were optional and in some cases required the teacher to have an extensive knowledge of local natural history. The books, then, were not considered for any sort of use in the Newfoundland module, although they could be used as background readers by teachers to gain an understanding of basic ecological concepts.

The overall result of the literature search was that there was no environmental education project or module among those searched which was suitable for use in Newfoundland elementary schools. There were, however, two projects which fulfilled at least some of the stated requirements and could be used as the basis for a Newfoundland module on the environment. It was obvious, therefore, that a special curriculum module on the Newfoundland environment for use in elementary schools would have to be designed.

B. CURRICULUM DEVELOPMENT MODELS

One of the first steps in designing a new module in environmental education was to select a curriculum development model which could be used in the actual planning and writing of the module. As Taba (1962) has said, "Usually the development of teaching-learning plans is left to classroom teachers. The curriculum guides are at best only skeletal

affairs, which merely describe some of the foundations, outline the content, and possibly suggest types of learning activities. Yet the job of organizing the multiple facets into a coherent unit, of applying the multiple criteria to the making of even fairly minute decisions is too complex not to deserve careful theoretical consideration."

Taba went on to say that "those responsible for generating theories of curriculum development omit a very important step, that of creating models for the ways of translating theoretical ideas into functioning curriculum and testing these ideas in classroom experiments." It was essential, therefore, in the formulation of any new unit of curriculum, to follow a very specific curriculum development model.

It was, however, not just sufficient to formulate new curricula, but to evaluate them as well, in the classroom situation. Gagne (1967) stressed the need for evaluation of new curricula and quoted Sizer who saw a number of shortcomings in curriculum development, not the least of which was the absence of systematic investigations of the effects of introduction of new curricula and courses of study. Scriven (1967) also stated that evaluation is an important part of the process of curriculum development.

Having established the need for a curriculum development and evaluation model, the problem was then to choose one model from the many available.

In the field of environmental education, Stapp (1971) provided a strategy (model) as to how a school system might develop a comprehensive educational program, and this could also be adapted to the development of a

curriculum module for the schools. The model had nine phases or steps as outlined below:

I. Need for Developing an Environmental Education Program.

II. Establish an Environmental Education Committee to Develop and Implement the Program and to Facilitate Communication.

III. Establish the Goals and Sub-goals of the Program.

IV. Establish the Objectives (in terms of behavioural dispositions).

V. Review of the Literature Regarding Theories of Learning and Instruction that apply to the Formulation and Implementation of the Program.

VI. Establish the Curriculum Organization of the Program.

VII. Establish the Curriculum of the Program.

VIII. Establish a Comprehensive In-Service Teacher Education Program.

IX. Develop Instruments to Evaluate the Effectiveness of the Program.

As the model is for developing a whole program of environmental education, some of the steps were inappropriate for the development of just one aspect of a whole program, namely one module, and were, therefore, disregarded. This meant elimination of steps II, V and VI. Step VIII was still valid for even a module development, but as it was beyond the scope of this curriculum development plan to introduce in-service programs, the module itself had to cater for the fact that most of the teachers have no environmental study training.

The "reduced" model now appeared very similar to many other

models including that of Taba (op. cit.), p. 347. Taba's model for planning a unit of instruction had eight steps as outlined below:

1. Diagnosing Needs
2. Formulating Specific Objectives
3. Selecting Content
4. Organizing Content
5. Selecting Learning Experiences
6. Organizing Learning Experiences
7. Evaluating
8. Checking for Balance and Sequence

This model was perhaps better than the previous one as it focused more on the planning of the content (4 and 5) and learning experiences (5,6). According to Gagne (op. cit.), this was a very comprehensive definition of the domain of curriculum development which encompasses questions of learning methods and instructional techniques as well as those of educational measurement. However he recommended it to "those scholars in specific disciplines who have set out to improve existing curricula or to design new ones".

As it was the intention of the author to use Taba's curriculum development model in the planning, writing and teaching of an environmental education module, the model is now explained in greater detail.

In step one, the diagnosis which precedes the planning of a unit is a fairly general analysis of problems, conditions and difficulties, and consists of drawing together already existing information or securing new information regarding a new approach or neglected needs. The data can be gathered from various sources such as society, schools, teachers and students.

In the second step the task is to translate the general objectives

of the school into specific objectives arising from the needs. The objectives formulated should include material on each of the following:

1. Concepts or ideas to be learned.
2. Attitudes, sensitivities and feelings to be developed.
3. Ways of thinking to be reinforced, strengthened or initiated.
4. Habits and skills to be mastered.

Selecting content occurs at several levels: the central topic and its dimensions, the focussing ideas in the light of which the topic or the unit is to be developed, and the specific facts and details which will serve to develop the focussing ideas. So basically, there are three sub-steps, namely:

1. Selecting Topics
2. Selecting Basic Ideas
3. Selecting Specific Content

This step is followed by the logical organization of the content. The topics, ideas and the concrete content samples need to be arranged so that there is a movement from the known to the unknown, from the immediate to the remote, from the concrete to the abstract, from the easy to the difficult - in other words, an inductive logical arrangement of the content and a psychological sequence for learning experiences for the facilitation of learning.

When the content has been logically organized, the next step is to select learning experiences, because, unless mastery of content is the sole objective, a content outline is only a partial plan for learning. Learning experiences involve four different stages. In the first stage, the learning activities introduced are essentially introductory, for

opening up the topic and for orientation. In the second stage of development, analysis and study, the experiences are designed to develop various aspects of the subject and to provide the needed factual material. This stage is followed by activities which help students to generalize, and, finally, there are activities designed to apply what has been learned, to assess and evaluate, or to set what is learned into a larger framework. When the learning experiences have been selected they have to be organized. The most important requirement for adequate learning experiences is that they follow a sequence which makes continuous and accumulative learning possible. The selecting and organizing learning experience stages also include the selection of materials such as textbooks.

The seventh step in the model includes evaluation. Evaluation consists of determining the objectives, the diagnosis, or the establishment of baselines for learning and appraising progress and changes. Naturally all evaluation is more accurate and objective if the evaluative judgements are based on evidence, from students, teachers and written tests.

After the outline for a unit is completed in writing, it is necessary to check the overall consistency among its parts. The proper design and planning of a module, then, must follow these eight steps as laid down by Taba.

Since Taba's model was published in 1961, it does not incorporate some of the more modern ideas of educational thought, notably in the

realm of affective objectives and selection of instructional materials, and in the realm of evaluation.

Objective writing has been revolutionized as a result of the work of Bloom and others. Objectives can be classified as belonging to the Cognitive Domain (Bloom et al), 1956, Affective Domain (Krathwohl et al), 1964, and the Psychomotor Domain. Mager, (1962), has supplied guidelines for writing behavioural objectives in performance terms, which were followed in this module.

There is, nowadays, a great range of instructional media from which a teacher can choose, and it is, therefore, important at an early state of curriculum development to decide upon the audio-visual materials to be used.

A large amount of material concerning curriculum evaluation has been published since Taba's book was published, which is very comprehensive in its scope, but as the main emphasis at this time is on the development and writing of the module, and its initial teaching and testing, the complex and elaborate methods of evaluating the unit were abandoned in favour of less rigorous evaluative schemes.

Therefore, in the preparation of this module, Taba's model for curriculum development was used, with the one modification involving media choice. The revised Taba model is outlined below.

1. Diagnosing Needs (of Society, Schools, Teachers, Students)

2. Formulating Specific Objectives

   (a) Overall Objective
   (b) Specific Behavioural Objectives – Cognitive
   – Affective
   – Skills

3. Selecting Content

   (a) Major Topics
   (b) Basic Ideas
   (c) Specific Content

4. Organizing Content

5. Selecting Learning Experiences

   (a) Introductory
   (b) Developmental
   (c) Generalizations
   (d) Application

6. Choice of Media of Instruction

7. Organizing Learning Experiences

8. Evaluation

   (a) Student Tests (cognitive and affective)
   (b) Teacher Opinion (as recorded through the use of a systematic interview procedure)
   (c) Developer Opinion
   (d) Students' opinion

9. Checking for Balance and Sequence.

CHAPTER III

DEVELOPING THE MODULE

A. ESTABLISHING THE NEEDS

The first step in the development of this module, following the modified Taba Curriculum Development Model (see Chapter II, Section B), was to establish the needs for such a module..

Society's need for such a module in Canada and Newfoundland was established by reference to the literature already referred to in Chapter I, (B. JUSTIFICATION FOR THE STUDY).

In 1972, the U.N. Conference on the Human Environment was held in Stockholm, Sweden, with Canada as one of the participating nations. One of the principles adopted (No. 19) pressed for environmental education across the country. The final report of this study (Rioux, 1973) urged the development of various types of environmental education programmes in the provinces. In Newfoundland itself, various conferences and organizations have urged the development of environmental education programmes for the schools.

The Newfoundland Teachers' Association, which represents all teachers in the province, sponsored a Short Course on Environmental Education in 1972, expressing the views of teachers in this area. Eight local teachers, when approached by the author with regard to the possibility of help in the field-testing of the module, expressed the opinion that it was about time that environmental modules were introduced into the schools.

The opinions of students with regard to their needs for environmental education were not sought until after the completion of the first field trial, at which time their views were solicited in a questionnaire. One question in particular asked students whether all other students should do such a course and why. The replies were overwhelmingly yes, (126 Yes and 6 No), with a variety of answers being given as to why they considered that all elementary students should do the course. It appears, then, that elementary students do perceive a need for environmental education in their own schools. (For a more complete statement of the needs for the module, see Chapter I.B).

B. FORMULATION OF OBJECTIVES

Having established the need for a module in environmental education, the next step was to outline the overall objectives for the course. A major objective of the module was for students to learn about "their local environment, especially the climate, and the more important plants and animals, and how these organisms are adapted to live in this particular environment".

The specific behavioural objectives were written after the major topics were delineated. These objectives were written as suggested by Mager (1962), and formulated so as to cover a variety of levels of objectives as outlined by Bloom et al (1956) in A Taxonomy of Educational Objectives: Handbook I, The Cognitive Domain, and by Krathwohl et al (1964) in Taxonomy of Educational Objectives, Handbook II, Affective Domain. The full list of performance behavioural objectives

is in Appendix E.

It was also hoped that students would develop a positive conservation attitude to the environment as a result of the module but, because of a lack of suitable measures of attitude, progress towards this objective could not be ascertained. Cognitive and affective domain tests were produced to test these overall objectives. (See Chapter III, H. (a) and (b)).

Other objectives for the course were also formulated, concerning the operation of the module. It was also hoped that students would understand more of the procedures of scientific experimentation as a result of the many experiments in which students are involved. The use of activities in the lesson was to involve the students in the operation of the module, in the hope that it would make students more responsible for their own learning. Another minor objective of the module was to help students develop their ability to record data and the subsequent analysis of such data, and formulation of conclusions. It was hoped that the use of group work would encourage social interaction between students, leading to greater co-operation among them.

C. SELECTING CONTENT

Rioux (1973) in his report (p. 47), suggested five fundamental ecological concepts, namely:

1. Living organisms depend on environment with certain characteristics.
2. Life forms interact.
3. Energy is the link between all organisms and their environment.

4. Organisms respond to a continuous process of change in their environment.

5. For each of these changes there are related consequences (e.g. a species adaptation).

In such a short-term module, it is impossible to include all five concepts and do each justice. This module focusses on the first concept relating organisms to their environment, and, to a lesser extent, concepts two, four and five. Concept three was not examined in the module as the topic of energy is a difficult one to deal with in such a short time.

With the concepts outlined, the next step was to decide on the topics to be included which would cover the concepts and the overall objectives.

The major topic selected was that of the Winter Environment in Newfoundland, with the primary focus on the adaptations of the animals and plants which survive winter.

The reasons for this choice were two-fold. Firstly, the adaptations which Newfoundland animals possess to help them survive winter are, for the most part, fairly obvious and can be easily demonstrated in the classroom. Secondly, the season of the year to be studied had, of necessity, to fall within the school year (September to June). Spring and Fall are very brief seasons and would have been too short to allow a five-week course to study them. Summer (June, July and August) falls outside the school year and, hence, could not be studied, even though it is normally considered to be the best season for field trips. This left Winter (December to March) as the only major season

falling within the school year.

The Sub-topics were chosen so as to cover the concepts and objectives. In order to infer the effect of the harsh winter climate on the local animals and plants, it was decided to make a brief study of the winter climate. It was also necessary to look at both the animals and plants which are active here in winter, so a sub-topic on winter-surviving animals and plants was deemed necessary. Another sub-topic was also included, dealing with some of the inter relationships of plants and animals in winter. As the adaptations of such organisms suggest how they can survive winter, another topic dealing with winter adaptations was also produced. As Rioux (op. cit.) had stressed the importance of children learning about their own local environment (p. 50), the observation of ecosystems (p. 54) and activities in the "field" (p. 51), a section was included on those animals and plants which could be found in the immediate schoolyard environment.

Hence, under the major topic of "The Newfoundland Winter Environment", five sub-topics were identified which covered the major and minor objectives of the course, namely:

1. Winter Weather (Climate)
2. Animals and Plants of Winter
3. Adaptations of Such Organisms
4. Interrelationships of Animals and Plants
5. Observation of Local Ecosystem

The subject material to be dealt with in each sub-topic was then produced and can be referred to in the module.

D. ORGANIZING CONTENT

The next step in the process was to logically organize the

content already delineated.

It was felt that as the severity of the winter climate placed limitations on the animals and plants of the area, the sub-topic of winter weather should be dealt with first, focussing on the major aspects of our winter climate.

It would then be logical to look at the types of organisms which can survive winter here, and also to look briefly at examples of organisms which cannot. As animals appear intrinsically more interesting to children (Badaracco, 1973), it was decided to look at animals and whether they can survive winter or not. Then the plants could be dealt with in the same way.

Having listed which animals and plants survive winter, it seemed that it would be logical to now include the observation of the local ecosystem by the use of field trips. As animals are difficult to spot at the best of times, this entailed looking for their "signs" rather than the animals themselves. This in turn meant dealing with "signs or traces" which animals leave, and how to identify the animals producing them.

After identification of the animals and the plants of the local ecosystem, it would then be appropriate to look at their interrelationships (food, shelter, etc.) and finally, the adaptations which plants and animals possess to survive through winter.

It was felt, finally, that it might be better to deal with animals and their adaptations, etc., first, in one section; and then the plants later on, as students would likely find more interest in dealing with animals first as Badaracco (op. cit.) has already shown that children are more interested in animals than in plants. Besides, the importance of plants to animals would

only come out after a look at the needs of animals in winter. The final organization of content appeared thus:

1. The Winter Climate
2. Animals — Which are active in winter?
   Which are present in the schoolgrounds?
   Interrelationships.
   Adaptations.
3. Plants — Which are active in winter?
   Which are present in the schoolgrounds?
   Interrelationships with animals.
   Adaptations.
4. Summary — Including the concepts of climate and adaptations.

For the full details of the content covered, refer to Appendix C, which contains the final revision of the module.

E. SELECTING LEARNING EXPERIENCES

Once the content had been selected and logically organized, it was then necessary to convert this content into a form which could be used by students and teachers and was pedagogically sound, for as Taba (op. cit.) says, "Unless one assumes that mastery of content is the sole objective, a content outline is only a partial plan for learning".

In order to help with the conversion from content outline to learning plan, Taba (op. cit.) lists four types of learning experience which are sequential, namely, introductory, developmental, generalization and application.

Each sub-section of the module should begin with an introductory lesson which serves as a source of motivation and as an introduction to the section. Developmental lessons, as the name suggests,

TABLE I

A Table showing each lesson of the module classified according to Taba's (1962) types of learning activity

Lesson	Topic	Learning Activity			
		Introductory	Developmental	Generalization	Application
1	Winter Temperatures	✓			
2	Other Features of Winter		✓	✓	
3	How Animals Prepare for Winter	✓			
4	Evidence of Animal Activity		✓		
5	Animal Field Trip		✓		
6	Identifying Prints		✓		
7	Interpreting Tracks		✓		
8	Animal Adaptations to Winter			✓	
9	How Plants Prepare for Winter	✓			
10	Plant Field Trip		✓		
11	Plant Adaptations to Winter I		✓		
12	Plant Adaptations to Winter II		✓		
13	The Uses of Plants			✓	
14	Summary			✓	
15	Post-test				✓

are ones in which the section of the curriculum is actually developed. In the generalization lessons which follow, the facts synthesized in the developmental lessons are used to produce generalizations about the topic. Finally come the application lessons, in which these generalizations are used to solve novel problems, or to make conclusions about novel situations.

Taba's scheme for producing a lesson sequence has been followed in this module. Table I shows each lesson in the module classified according to Taba's scheme.

According to Piaget and Inhelder (1969) students of the ages ten and eleven for whom the module was designed are at the Concrete Operational Stage of Intellectual Development, where they need contact with concrete objects in order to be able to abstract relationships and concepts. Hence it was necessary to provide students at this stage of development with concrete materials (i.e. equipment, models, etc.) in the lessons.

Rioux (op. cit.) stated (p. 51), that as the learner makes contact with the real world of people, things and events, he develops "self" concepts out of those described initially by the teacher. Hence activities in the "field" are crucial in that they provide the key integrator and test of fit between concept and reality. In this statement Rioux gave a forcible reason for using activities as the bases of lessons in the module.

If the learner is involved actively in learning experiences, he or she feels more involved in the learning process, and, hence, is

more highly motivated and becomes responsible for his or her own learning. This approach to learning is being used successfully in many new science curricula and was also used here in this module.

The various types of activity employed in the module varied as to the nature of the topic. They included group discussions, class discussions, field trips, experiments and individual research. (Table I shows the classification of the lessons according to Taba's four types and type of activities involved.

F. CHOOSING INSTRUCTIONAL MEDIA

Much of Taba's research was undertaken in the 1950's at a time when the educational world was not yet immersed in the technological era, and so perhaps it is not surprising that her model neglected specific mention of media to be used as instructional strategies. Nowadays there is need for a careful choice of instructional media and so this section is included here. The range of media to be used can be sub-divided into reading materials, audio-visual materials, models and experimental equipment.

(a) Reading Materials

In order to keep the cost of the module at a minimum, no student reading materials were provided. In lessons 1 and 2, teachers may, if they so require, make photographic copies of the climatic data

in Appendix A of the module, but this is the only material which might be supplied to students.

In some parts of the module students are required to find information relating to native animals and plants, but these materials were not provided for two reasons. Firstly, a brief survey of the schools involved revealed that they had adequate resource information in their libraries, or the children had recourse to such at home, and secondly, most of the information required can be obtained in pamphlet form from various (mostly local) government organizations, free of charge. Hence a list of local organizations supplying free literature of help in the module is found in Appendix G.

While no written materials are provided for students, a Teacher's Guide was included, and may be referred to in Appendix C.

(b) Visual Materials

A series of twenty-eight 35mm colour slides was produced by the author for use with Lesson 3, concerning common Newfoundland animals. It was originally intended to use original slides of the relevant animals, but it proved impossible to obtain good originals, even though many government departments and professionals were contacted. As a result, some of the slides are originals (of the author) and the majority are copies of photographs from various books and journals. A list of the slides and information on each of the animals is also supplied to schools using the slides.

Another series of six colour slides has been produced for

Lesson 8, Activity II, which deals with coat colour change of the snowshoe hare, ptarmigan and weasel in summer and winter.

A series of full-scale drawings of selected Newfoundland tree leaves has been produced for Lesson 12, Activities I and II, where students need to make cut-out models of such leaves in the experiments.

A series of track cards has been produced for Lesson 6. There are twenty different sets of animal footprint drawings for use by students. Each card has a full-size drawing of the hind footprint of a native animal, with measurements, and, in addition, some have a drawing of a series of tracks of the animal. From this set of information, students interpret and try to guess the identity of the animal making such tracks.

Master track cards have been produced for the teachers. The front of each card is identical to the students' cards, but on the back of each card is the name of the animal producing such tracks, as well as hints on the major identifying features of the prints (i.e. presence or absence of claws, footpads, hooves, etc.)

(c) Models and Equipment

A series of eight wooden models representing animals' feet has been constructed for use in Lesson 8, Activity I. The life-size models represent the feet of the snowshoe hare, fox, ptarmigan and lynx for summer and winter. They are used by students to illustrate the effectiveness of snowshoe feet in snowy conditions, as compared with normal (summer) feet.

A wooden meter scale for the measurement of leaf wind-

resistance has been constructed for use with Lesson 12, Activity II.

The other equipment necessary for the successful operation of all the activities is readily available in most schools or is easily obtainable from local stores. (i.e. baking tins, salt, drinking straws, etc.).

The models, slides and, in some cases, thermometers and electric fans were loaned to schools field-testing the model, but in future years schools will be able, if they so desire, to purchase copies of the models and slides.

As can be seen, the cost of the materials for the module is minimal, which is in keeping with one of the aims of the module.

A complete list of materials may be found in the module in Appendix C, under the heading "Materials Required".

G. ORGANIZING LEARNING EXPERIENCES

With the relevant learning experiences selected and the instructional media chosen, the learning experiences were organized into a final teachable form. Topics which were introductory in nature were placed first in the four sub-sections, followed by lessons which were primarily developmental in nature, and then generalization and finally application lessons. (Refer to Table I).

Some topics (e.g. Plant Adaptations) were too lengthy to be dealt with in one class period, so two class periods were allocated to such topics.

The final sequence of lessons was so programmed that the

types of learning activity were varied from one lesson to the next. For instance, the three field trips were spread out with other types of activity between them.

A series of out-of-class activities was produced, which was ancillary to the main lessons, and these were sequenced to best follow relevant lessons. The final result of this organization of learning experiences can be found in the module.

H. EVALUATION

The precise means by which the success of the field trials of the module were to be judged were delineated once the preliminary organization of the module was made. The purposes of the evaluation were (a) to determine to what extent the objectives of the module have, in fact, been realized, and (b) to answer the questions outlined in Chapter I under the heading C. PROBLEMS TO BE INVESTIGATED.

Various instruments were developed to evaluate the success of this particular module.

In order to investigate the first problem, as to whether it is possible to produce a good module, one needed first to know the answers to the other five problems. To answer the problem concerning students' environmental cognitive knowledge, a student cognitive post-test was developed, as described later. An attitude to environment test was developed to help answer problem 3. Teacher interview schedules were drawn up to throw more light on the suitability of the modules for the various grade levels, and the proper use of the module

by teachers with different backgrounds. Teacher and student opinionaires were constructed to answer the final problem concerning attitudes to the course. The sections below deal with each of these instruments in turn.

(a) Student Cognitive Pre- and Post-test

A post-test has been developed by the author which measures the environmental cognitive knowledge of the students, as covered in the module. The test items were constructed to test each behavioural objective. The original test was administered to fifty students in the first field trial as a pre-test, but results showed it to be both too easy (60% was the average mark and only 10% of the students failed) and unreliable (a coefficient of reliability was calculated as $r = 0.29$), using the Kuder Richardson Formula 21 (Ebel, 1965). Consequently the test was rewritten and administered as the post-test to the same fifty students. Statistical analysis of the data showed that only 14% of the students answered less than 50% of the items correctly, which was similar to the average failure rate in other subjects for the classes, with a mean of 66.8% and a reliability of $r = 0.79$. (See Table 2). The difficulty of each item was also assessed (by subtracting the wrong from the correct answers for the item), as was the discriminating power of each item (based on how many more students in the top 50% of the class than in the lower 50% made the correct choice).

As a result of this analysis, several items which appeared too difficult were made easier, and easier questions made more difficult.

Some items which appeared confusing (more lower-scoring students than high-scoring got them right) were more clearly specified. (For a greater discussion on item analysis, see Diederich, "Short Cut Statistics", p. 6ff).

According to Diederich (1964) "Maximum reliability and dispersion of scores will be attained if every item is answered correctly by somewhere between 60% and 70% of the students tested." (p. 10). The average score for all students was 66.8%, so that if some of the individual items were changed, the test would be quite reliable.

The computed reliability of the test was 0.71 (= 50), and this fell midway in the range of 0.60 to 0.80 for the reliability of teacher-made tests, according to Diederich (op. cit.).

The test was also checked for validity, both content and construct. One science educator and two biologists checked each item as regards the content it was testing, and revisions were made where items appeared invalid. Construct validity was ascertained by checking each of the items against the cognitive behavioural objectives, and each item determined to correspond. The test has obviously not been highly validated as the validity was checked by only a few people.

This revised test (see Appendix D.1, The Post-test) was used in the second field trial as both a diagnostic pre-test and a summative post-test. If students did well in particular sections of the pre-test, teachers were advised either to delete that section of the module or change it to suit their own purposes, but, in fact, none of the teachers did so.

(b) Attitude to Environment Test

In order to obtain information on the problem of whether the module would cause a change in the attitude of students to their environment, the production of an attitude test was necessary. It was originally hoped that a reliable and valid attitude to the environment test for elementary school students could be found in the literature, but a search of the literature available and a computer search of ERIC documents revealed few such tests and none of these could be used either because the test was too specific to the program it was developed for, or had not been proven reliable or valid.

As a result of the lack of available tests, the author tried to develop an attitude test for use in Newfoundland with elementary school students. The test (in Appendix D.2.) was administered to the fifty students in the first teaching trial at the same time as the pre-test. However the results indicated that the test was not very reliable as the scores were not well scattered, and it was reluctantly decided to omit the attitude test from the second field trial. Most of the marks were quite high so it would have been almost impossible to record any obvious change in attitude as a result of the course.

(c) Teacher Interview Schedule

In order to assess the effectiveness of each activity in the module as comprehensively as possible, and to assess how well the module could be used by teachers, an interview schedule was constructed. Either questionnaires or interviews could have been used but, as Kerlinger

(1964), p. 467, states, "Interviews and schedules (questionnaires) are ordinarily quite direct. This is both a strength and a weakness. It is a strength because a great deal of the information ... is fairly straightforward and can be gotten from respondents by direct questions. Though the questions may have to be carefully handled, respondents can, and usually will, give much information directly." The interview schedule was used as the more straightforward means of obtaining teachers' views of the teachers' manual, the activities and student performance.

The interview schedule was designed along the lines suggested by Kerlinger (op. cit., pp. 469-475), and Goode and Hatt (1952, pp. 132-169). Several well-known interview schedules, suggested as excellent by the previous authors, were also consulted before the construction of the schedule, as guides to good questions. (Miller and Swanson, 1958, Appendix III, "The Interview", pp. 264-275, and Sears, Maccoby and Levin, 1957, Appendix A, "The Interview Schedule", pp. 491-501).

The purpose of the schedule was to gain information about several processes. It was necessary to know if teachers could read and easily follow the teachers' manual and properly organize the activities. Information concerning the actual operation of the lesson, and how teachers carried out the lessons, was needed. It was also important to know whether the students could carry out the activities successfully and enjoy themselves while doing them, as this information would not be registered in the student post-test. Teachers' opinions on the operation of the lesson, and anecdotal information on the students while carrying out the activities-

were also to be canvassed in the interview. These types of formative evaluation of the module are not covered by other tests. If students did badly on the post-test, such information could give us some indication why - was it the poor instructions to teachers, the equipment, or the operations involved in the activities?

The interview schedule questionnaire was divided into sections dealing with the different types of information necessary. Section A deals with the Teachers' Guide and the information and instructions contained therein. In Section B, the questions are concerned with the actual operation of the lesson in the classroom, while Section C is concerned with opinions of the activity. A further section, D, deals with the use of the out-of-class activities.

The original interview schedule was checked over by various experts before its first use during the first field trial. As a result of the experiences gained during these first interviews, many of the questions were revised and reworded. The revised interview schedule was used with the four teachers involved in the second field trial, and can be consulted in Appendix D.4.

The teachers filled in the questionnaires after they had taught the lessons, and the developer then went to interview each teacher, asking for more information than was given initially, if required. Each teacher was interviewed once a week on the average, where conditions permitted.

It must be remembered though, that the interview schedule/questionnaire has not been exhaustively tested for reliability or validity but it was hoped that the combination of questionnaire and interview would

supply the greatest amount of information on the individual activities.

(d) Student Questionnaire

A student questionnaire was also developed (see Appendix D.4) to find the students' opinions of the course. The first form of the questionnaire was administered with the post-test to twenty-five students at the end of the first field trial, and was subsequently modified for use at the end of the second field trial, (see Appendix D.4) with 130 students.

(e) Teacher Questionnaire

A teacher questionnaire was also developed to find out the overall reaction of teachers to the module at the end of the field trials, including objectives, content, learning procedures, the activities, sequencing, post-test, overall reactions and possible alterations, additions and deletions. Once again the questionnaire was administered at the conclusion of the first field trial, and modified as a consequence for the second field trial. Copies of the revised questionnaire may be found in Appendix D.5.

The above instruments produced information which was used to decide to what extent the module had actually fulfilled the stated objectives of the course, and whether or not changes could usefully be made to the module before it could be used by many more schools in the province.

(f) Checking for Balance and Sequence

Throughout the development and writing of the module, balance

was checked by making certain that no lessons in the activity were out of proportion as regards time, to the behavioural objectives stated at the beginning for these sections. Sequencing of activities was checked at various times to make certain that one lesson logically flowed into the next, where possible.

The result of these nine steps of Taba's modified curriculum development model was the module which was developed and tested on a small scale in the first field test and subsequently revised for the second field trial: (See Appendix C).

I. THE ACTUAL OPERATION OF THE MODULE

The first copy of the module was field-tested over a six-week period in February and March of 1974, with two Grade VI classes at School X (a Metropolitan Area School). One class was taught by the regular science teacher and the other by the author, using three lesson periods of thirty-minutes duration per week. At the end of each week the science teacher and the author discussed the operation of the module and made alterations to the lessons where necessary. As a result of these discussions, changes were also made to future lessons where necessary. As has already been mentioned (Section H, Evaluation) cognitive pre-tests and attitude tests were administered before the first field test, but both instruments proved unreliable. At the end of their first field test, the revised post-test was administered to all students (for results see Section H. (a) Student Cognitive Tests). The attitude of students to the course was analysed as the result of the student

questionnaire, and the comments of students to teachers (both those teaching the course and regular classroom teachers). The teacher opinion of the module was also used in the evaluation of the module.

As the results of the post-test were good (86% of the students achieved 50% or more on the post-test), and were in line with the class marks for other subjects, the cognitive aspect of the module was accepted as of a reasonable standard for Grade VI students. Teacher opinion of the module (from the interview schedule and spoken comments) was also favourable, and the students very definitely liked the course (25 liked, 0 disliked), and thought that they had learned a lot from it. Reaction from other teachers in the school, and student teachers (who observed many of the classes) was also very favourable. As a result, the first field trial was considered to be workable and the module was rewritten in accordance with teacher and student suggestions (from questionnaires, spoken comments), and as the result of an analysis of the post-test results, showing which sections of the course appeared to be difficult. The next step in the development of the module was to have it used again involving more students and teachers, with the revised instruments.

J. THE SECOND FIELD TRIAL

The module was rewritten in accordance with the changes felt necessary and in late March contact was made with other teachers interested in trying out the module. Two schools were selected, one, School Y, a city school, and the other, School Z, a rural school.

In each school, two teachers and two classes were involved, one a Grade VI class and the other a Grade V class (the latter to see if the module could be used successfully at lower grade levels). In all cases the teachers were regular classroom teachers with no major science background. (For more information on the schools and teachers involved see Appendix B).

Unfortunately, snowstorms delayed the early operation of the module enough so that neither school was near completing it by the time of the Easter vacation. Hence most of the module was taught after Easter during April and May, when the weather was not appropriate for the teaching of the winter climate.

In all cases the revised cognitive test was used as both a pre- and post-test, and the student questionnaires were completed at the end of the trial. The teachers were interviewed each week, using the schedule, and were also asked to complete the overall questionnaire at the end of the trial.

CHAPTER 4

EVALUATION OF THE FIELD TRIALS

Evaluation is the eighth step in the modified Taba (1962) curriculum development model. Taba mentions many forms of evaluation, but all, basically, can be classified as either formative or summative. Scriven (1964) has put forward the new term "formative evaluation" to describe evaluative procedures carried out during the development of a curriculum. According to Scriven (p. 43), "Any curriculum builder is almost automatically engaged in formative evaluation. He is presumably doing what he is doing because he judges that the material being presented in the existing curriculum is unsatisfactory. So, as he proceeds to construct the new material, he is constantly evaluating his own material as better than that which is already current. Unless entirely ignorant of one's shortcomings as a judge of one's own work, he is also presumably engaged in field-testing the work while it is being developed, and, in doing so, he gets feedback, on the basis of which he again produces revisions; this is, of course, formative evaluation."

Most of the formative evaluation of this module was carried out during the first and second field trials. Regular discussions were held with all the teachers using the module, while the actual teaching was in progress. The results of these discussions were used by the developer to make revisions to the module while it was being taught in the schools.

In a sense, all of the evaluative procedures used in the field trials and afterwards can be considered as formative. The final

revision of the module can only be prepared after further field trials encompassing a greater number and variety of teachers, students and schools have been evaluated. Likewise, proper summative evaluation of this module can only be undertaken when many more teachers and students field-test the module; and data are obtained using properly validated and reliable test instruments. This is outside the scope of this thesis which is only concerned with the initial production of a module, and its subsequent evaluation.

In this section on the evaluation of the field tests there has been no attempt to separate formative and summative evaluation procedures because, as has been mentioned already, all of the instruments can be thought of as being both formative and summative evaluation.

However the various types of evaluation used can be separated into one of three groups, depending on the exact time each was used during the development. The first type of evaluation occurred at the end of the writing of the module before it was used in the schools. A second set of evaluative procedures was used during the teaching of the module, and the third after the end of this period of teaching.

THE EVALUATIVE INSTRUMENTS

Before the module could be used in the schools, it had to be examined by both biologists and educators to ascertain whether or not the content was correct, and the teaching-learning procedures valid. Once this evaluation was completed the module was considered ready for the field

trials. The evaluative procedure used in this first stage of evaluation was the "Assessment by Experts".

The module was then used by teachers in the field trials. The teachers were asked for their opinions concerning each lesson in the module, particularly with regard to the appropriateness of the content, materials used and the teaching-learning strategies involved. The "Teacher Interview Schedules" were used to perform this evaluation. Unfortunately these schedules were not developed until the end of the first field trial, during which the author and the other teacher involved held regular discussions on each lesson in the module instead.

The final stage of evaluation occurred after the end of each of the field trials, as information was needed on the amounts of student learning which had taken place as a result of the module. The opinions of teachers and students were also required. The "Cognitive Post-test" was used, with the same test as a pre-test, to evaluate the knowledge gained by students as a result of the module. However, as the original test used as the pre-test in the first field trial proved to be inadequate due to many of the items being too easy or vague, the final test produced was only used as a post-test on the first field trial, but was used as both pre- and post-test in the second field trial.

The post-tests of the second field trial were also used to supply information on each of the test items answered, and to ascertain the degree to which the original objectives of the module had been achieved. This involved the technique known as "Test Item Analysis".

Each student involved in the field trials was asked to complete

a "Student Questionnaire" which requested their opinions of the module, especially whether or not they liked the course and why, and specifically which sections and/or activities they liked or disliked.

The teachers were also asked to complete a lengthy "Teacher Questionnaire" which asked for more specific information such as their opinion of certain types of activity, topic sequence, and other topics they would like to have seen included. They were also asked if they would use the module again, and whether they considered it worthwhile enough for all elementary teachers in the Province to use.

The results of these various evaluative procedures are outlined below.

A. ASSESSMENT BY EXPERTS

According to Johnson (1968, p. 6), "Only a specialist in a discipline can assess the internal significance of the substantive content." Unfortunately, environmental education is a newcomer to this province and there are no provincial specialists or experts in this field who could assess the substantive content of the module. As it was impossible, therefore, to have an assessment made of the module by environmental specialists, the module was examined by two biologists (for content) and two science educators (for validity of the educational procedures used) before and after the first field trial. As a result of these scrutinies, the environmental content was judged to be accurate, but some changes had to be made in the activities and procedures used in the lessons, in the first form of the module. The module used in the first field trials was rewritten to incorporate these changes.

TABLE II

A Table Showing the Results of the Teacher Interview Schedules for L

LESSON	QU. #	2	3	4	5	6	9	12	13	CHANGES NECESSA
		* P N	P N	P N	P N	P N	P N	P N	P N	
1		5 0	5 0	5 0	5 0	3 2	5 0	5 0	2 3	"Does winter always the same months in
2		5 0	5 0	5 0	5 0	3 2	5 0	5 0	3 2	
3		4 1	5 0	5 0	5 0	3 2	5 0	5 0	3 2	Objectives confuse p. paration for winter v adaptations in Lesso and 8.
4		4 1	5 0	4 1	5 0	3 2	5 0	5 0	0 5	
5		5 0	3 2	4 1	5 0	3 2	5 0	5 0	0 5	
6		5 0	5 0	5 0	5 0	3 2	3 2	5 0	1 4	
7		5 0	5 0	5 0	5 0	2 3	5 0	5 0	2 3	

TABLE II

nterview Schedules for Lessons 1 to 14. (See Appendix)

CHANGES NECESSARY	SUGGESTIONS	OTHER COMMENTS
"Does winter always have the same months in it?"	Contrast winter with summer.	
	Amplify climate section. Collapse lessons 1 & 2.	Why not visit a Meteorological Stn?
Objectives confuse preparation for winter with adaptations in Lessons 7 and 8.	Lesson long, so should be extended over two periods.	
	Would like to see more information on traces. Should develop more visuals for this lesson.	
		Difficult when insufficient snow.
	Should supply more information on animals and the types of tracks they produce.	Field trip should be attempted.
		Difficult when insufficient snow.

LESSON	QU. #	2		3		4		5		6		9		12		13		CHANGES NECESSA
		*P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	
8 & 9		5	0	5	0	5	0	5	0	5	0	5	0	5	0	0	5	Seem to overlap at cate material in Le
10		5	0	5	0	5	0	4	1	2	3	4	1	5	0	1	4	
11		5	0	5	0	5	0	5	0	2	3	5	0	5	0	1	4	
12		5	0	4	1	4	1	5	0	5	0	5	0	5	0	0	5	
13		1	4	5	0	5	0	5	0	5	0	5	0	5	0	0	5	Title misleading - be how animals an plants help each ot
14		5	0	5	0	5	0	5	0	4	1	5	0	5	0	-	-	

*P = positive answer
N = negative answer

CHANGES NECESSARY	SUGGESTIONS	OTHER COMMENTS
Seem to overlap and duplicate material in Lesson 3.		
	Lesson could be performed as library research beforehand.	Library facilities lacking in many rural settings.
	Is leaf stalk length which is important, not leaf size. Leaf models could be prepared beforehand as homework.	
Title misleading - should be how animals and plants help each other.	Could discuss recycling. Could include conservation.	
	Could include conservation. Could collapse Lessons 13 and 14 into one.	

B. TEACHER INTERVIEW SCHEDULES

Throughout both of the field trials, the teachers were interviewed at weekly intervals for their opinions of individual lessons. As the interview schedules used in the second field trial were not drawn up by the author until the end of the first field trial, it was not, of course, possible to use the schedule in the first field trial. However this teacher was interviewed using the revised module and the schedule during the period of the second field trial, as if he had participated in this second field trial, as the module had not been significantly changed since the first trial and as the developer desired to collect as many written comments on the module as possible. Hence in this section the replies of all five teachers in the two field trials are analysed.

The purpose of the interviews was to gain information on teachers' opinions of the objectives, activities, content, and suggested plans for each lesson while they were still fresh in their minds. They were also asked if they had any difficulties with obtaining required materials, and whether the students appeared to enjoy the lesson. At the end of each week the completed interview schedules were analysed and the results tabulated.

It is difficult to summarize the replies to all the questions on the fourteen lessons, but an attempt has been made in Table II to summarize most of the answers as being positive or negative. Comments from questions asking for opinions and suggestions (Questions 7, 8, 10 and 11) have been summarized in the columns entitled "Changes Necessary", "Suggestions" and "Other Comments".

The results indicate that the teachers were more than satisfied with the information describing the lessons in the Teachers' Guide, with the possible exception of three lessons. They also made several useful suggestions, and offered other comments. After the analysis of the table of results, the following decisions were made, based on teachers' recommendations and the developer's conclusions:

1. Changes to be made to individual lessons:

   (a) The information and objectives given in Lesson 1 will have to be changed so as not to suggest that December, January, February and March are always the only months that comprise winter, but that different months may constitute winter in a particular year, based on their monthly average temperatures for that year.

   (b) The objectives and content in Lesson 3 will have to be reworded to make it plain to teachers that all that is asked for is how animals react to the coming of winter, and not how they adapt to survive through winter. Then there will be no chance of an overlap with Lessons 8 and 9 on adaptations to winter survival.

   (c) The title of Lesson 13 should be changed to read "How can Animals and Plants Help Each Other in Winter?"

2. Suggestions made by teachers:

   All the suggestions recorded in Table II should be included in any future revisions of the module. In most cases this will simply mean a rewording of certain lessons in the

Teachers' Guide, but the suggestions concerning the development of visuals for Lesson 4, and information on animals and the tracks they produce, will take some time to produce.

3. Other Comments:

The comments made by teachers concerning difficulties involved in certain lessons (i.e. Field Trips), should be included in the text of any revision, to show that there are certain difficulties involved in the module, but that the results produced are well worth the extra trouble taken.

The table also shows that on some occasions teachers did change lessons to suit their own situations (Qu. 6.), and these modifications should be included as alternative lesson plans which are equally valid.

The replies to Questions 7 and 8 on how lessons were conducted and results used, varied greatly but were always in accordance with the suggestions in the Teachers' Guide. One major innovative approach, however, was used, and is worthy of special mention, namely team-teaching of two of the classes in one school. The participating teachers considered this approach successful, and, therefore, this approach (and others not used, e.g. individual learning) should also be mentioned in any revision of the module.

Lesson 10 caused problems in one school, because of the lack of library facilities in the community necessary for obtaining information on plants and winter. It appears that in such cases, some sources of

TABLE III

A Summary of the Replies to the Student Opinion Questionnaire
(See Appendix, 133 Questionnaires completed)

Question	Replies
1	Strongly like, 92; slightly like, 34; dislike slightly, 6; dislike strongly, 1.
2	Answers varied from the field trips, the experiments, the projects, the discussions, and the slides, to various sections of the course.
3	Answers varied from nothing to having to write down information, lack of films and live animals, to various sections of the course.
4, 5	The answers to these questions were difficult to interpret so they were categorized as to the sections (i.e. climate) mentioned.

	CLIMATE	ANIMALS	TRACKS	PLANTS	ALL	NONE
LIKE	5	78	28	43	9	0
DISLIKE	29	8	10	16	1	65

6	The answers were too varied to categorize. Many said they had learned a lot about their province, its weather, animals and plants, their adaptations and the tracks of animals.
7	(a) Yes, 125; No, 6; Maybe, 2.
	(b) Answers varied, but most were concerned with learning more about the province, its climate, animals and plants and because it was fun to do while also learning.

reference material may need to be supplied to schools for use with the module.

Use of the optional activities (Question 14) varied, but most were used and found to be worthwhile, and so should be included in revisions of the module.

The completed Teacher Interview Schedules provided very useful information on the individual lessons, and the results have been used to draw up a list of revisions which should be included in future editions of the module.

C. STUDENT QUESTIONNAIRES

At the end of the second field trials questionnaires were handed out to all the students participating in the module. It was not possible to give out questionnaires to the students involved in the first set of field trials because of school time-tabling difficulties at the end of that term. The purpose of the questionnaire was to ascertain whether or not students liked the module and all its lessons and activities. If one or other section of the module was disliked by the great majority of students, then that particular section could be examined and, if possible, changed to make it more pleasing to students.

The results of these questionnaires are tabulated in Table III for the second set of field trials. One hundred and thirty-three students completed the questionnaires at the end of the second field trial.

Sixty-nine per cent of the students said that they strongly liked the course and 26% liked it slightly, while only 5% disliked the course.

The answers to the second and third questions varied consider-

ably. The reasons given for liking the course included the presence of field trips, the experiments, the animal and plant life history projects, the class discussions and the colour slides. The things which students did not like about the course were the lack of films and live animals, and, in addition, having to write things down in their books!

It was difficult to interpret from the replies to Questions 4 and 5 exactly which individual lessons were liked or disliked as most answers were of the type, "I liked the lessons on the animals." The developer, therefore, categorized the lessons into the following areas: Climate (Lessons 1 and 2); Animals (3, 4, 5, 8, 9); Tracks (5 and 7); Plants (10, 11, 12, and 13). The replies were also classified in all and none, like/dislike categories. The majority of students expressed a preference for the animal lessons (7, 8), but all sections received some votes. Sometimes students recorded two categories which they liked (or disliked) most, and in these cases both were recorded. (This explains why the total of likes is greater than the number of students). The greatest number of dislikes recorded was for the section on climate, but as some of the classes had already studied the climate in previous geography classes, it is difficult to decide whether the dislikes were genuine haters of the climate unit, or merely saturated with climatic topics in other courses. As with the likes, votes were recorded against all topics. Probably the most significant total is the 65 (50%) students who said that they disliked none of the lessons. This may indicate that students who recorded likes or dislikes merely did so because asked, rather than because they really disliked or liked certain lessons. On the strength of these results, there is

no evidence to suggest major dissatisfaction with any of the lessons, especially as almost half of the students said that they disliked none of the lessons. From the students' comments there appears no reason to change any of the lessons.

Students' choice of the most worthwhile thing they learned from the course varied (Question 6). Many mentioned the fact that they had learned a lot more about their own province, the climate, the animal and plants, the tracks and the adaptations of various animals and plants. Several also made mention of the fact that they learned a lot from the course and had fun doing it. The module is certainly worthwhile if students can enjoy themselves while learning something useful.

The answers to Question 7, "Do you think all elementary school students should do the course?", were overwhelmingly yes. One hundred and twenty-five (94%) of the students replied yes, a strong indication that students thought the project worthwhile. Not all the no's were, in fact, negative responses. One "No" student gave as his reason that not all schools would have the equipment necessary to do the course - an astute observation for an elementary student!

The reasons given by students for their "yes" replies again varied but most mentioned that other students would learn a lot more about their province, its climate, animals and plants, and at the same time would have a lot of fun while learning.

The results, then, of the student questionnaires showed a very positive reaction to the teaching of the module and, therefore, no changes

TABLE IV

A SUMMARY OF THE REPLIES TO THE TEACHER OPINION QUESTIONNAIRE

Question	Answers			Comments
	P.	O	N	
1 (a)	3	–	–	
(b)	4	–	1	Lesson 13 problem unclear
2 (a)	4	–	1	Some too simple for Grade VI
(b)	4	–	–	
3 (a)	4	–	1	Better for Grade V
(b)	4	–	1	Lesson 3 too long. Lessons 13 and 14 too short.
4	5	–	–	
5	5	–	–	
6	3	–	2	8, 9 covered in 3; could be combined at teacher's discretion.
7	5	–	–	
8	3	–	2	Climate, then plants, then animals; put 8 and 9 with 3.
9 (a or b)	3	(a)	2	(b)
10 (a)	4	–	1	
(b)	4	1	–	
11 (a)	5	–	–	
(b)	3	–	2	Readability problem for poor Grade V's. Questions 24, 30, 31, 32.
(c)	4	1	–	
12	4	–	1	Should start course in January.
13	2	2	–	Maybe good with Grades IV and VII.
14	5	–	–	
15	5	–	–	

TABLE IV (Continued)

Question	Answers			Comments
	P	O	N*	
16	5	-	-	
17	See Test			

* P - denotes positive reply
N - denotes negative reply (For reason see Comments column)
O - denotes other reply - i.e., non-committal, unsure

are necessary to make the module a more pleasant learning experience for students.

D. TEACHER OPINION QUESTIONNAIRES

After the administration and marking of the student cognitive tests, the teachers co-operating in the study were asked to complete the teacher-opinion questionnaires. The results of these questionnaires concerning the teachers' opinion of the module as a whole are shown in Table IV.

As can be seen from Table IV, teachers encountered very little difficulty with the module as a whole, and the problems which arose are of a comparatively minor nature and can be corrected easily by slight revisions of the Teachers' Guide and the student cognitive test.

Most teachers felt that the module was feasible for the average Newfoundland elementary school teacher, provided that the module was begun in January and not left until later when the chances of a snow cover on the ground were minimal. (Question 12)

In reply to Question 13, two of the teachers felt that the module could be used with Grades IV and VII with only slight modification, while two of the others said that its use with other grades would depend on local circumstances.

All the teachers were full of praise for the module (Question 14). Answers received included "excellent"; "a fine module which I enjoyed teaching"; I enjoyed doing it very much. The pupils did too".

All of the teachers thought it fulfilled a real need (Question 15)

and all said that they would certainly use it again.

It was not possible to tabulate the replies to Question 17 on Table IV and, therefore, the reasons listed by teachers are listed below:

1. The course is very concise and well planned. It is fairly easy to follow.
2. The course can be carried out in a short period of time.
3. There is a definite need for a course of this nature.
4. The data have been well researched and have a fair amount of depth.
5. It includes two field trips and is experiment-oriented.
6. It can add variety to the Grade VI science program.
7. Stimulates students' interest in biology.
8. Makes students more aware of environment.
9. Makes teachers do some research into Newfoundland animals and plants.
10. Its subject matter is very appropriate (Newfoundland materials).
11. It is highly motivating.
12. The children enjoy it.
13. It introduces our students to a better understanding of our environment.
14. It could be used as a springboard to a broader scope of ecology.

E. COGNITIVE TEST DATA

A test was constructed to measure the amount of cognitive learning by the students during the course of the module. This test was administered before the teaching of the module, as a pre-test, and

TABLE V

A TABLE OF CLASS PERFORMANCE DATA ON PRE- AND POST-TESTS

School	Grade	Pre-test				Post-test			
		n	Mean	St. Dev.	% Pass	n	Mean	St. Dev.	% Pass
X	VI	25	-	-	-	25	34.5	6.22	88.0
	VI	25	-	-	-	25	32.3	5.59	84.0
Y	V	34	16.82	5.74	8.8	41	26.02	7.60	65.8
	VI	31	23.48	5.62	38.7	32	29.70	6.99	78.1
Z	V	32	28.78	6.57	75.0	29	44.10	3.98	100.0
	VI	36	23.13	5.76	33.0	35	35.17	6.10	97.1

TABLE VI

A TABLE SHOWING RESULTS OF T-SCORE CALCULATIONS FOR CORRELATED SAMPLES FOR THE PRE- AND POST-TESTS IN THE FOUR CLASSES OF THE SECOND FIELD TRIAL*

			Pre-test		Post-test		r	t	p
School	Grade	n	Mean	Variance	Mean	Variance			
Y	V	33	16.8	35.68	25.06	56.19	0.65	8.11	.0005
	VI	30	23.4	30.19	29.80	46.66	0.754	7.76	.0005
Z	V	27	28.30	45.31	44.20	16.64	0.52	14.32	.0005
	VI	34	23.06	29.63	35.47	38.14	0.60	10.98	.0005

*Includes only those students who completed both pre- and post-tests.

after completion of the module as a post-test. In this way it was possible to measure the increase in environmental knowledge which might have been due to the teaching of the module. The pre-test used in the first field trial was found to be inadequate, as discussed earlier, and the subsequent test which was produced served as the post-test only, for students in the first field trial. As this particular test was felt to be better than the first test, it was subsequently used as both pre- and post-test in the second field trials. The class results on the pre- and post-test are shown in Table V. The class results on the pre- and post-tests in the first field trial are also included for comparison. Each of the four classes in the second field trial recorded an increase in the mean scores between the pre- and post-tests.

Two null hypotheses were constructed in order to check the statistical significance of these increases.

H_1 There will be no significant differences between the mean scores on the pre-test and the mean scores for the post-test for each class.

H_2 There will be no significant difference between the mean gain scores recorded for each class.

The first hypothesis was tested using one-tailed t-score tests for correlated samples for each set of class scores. The results are shown in Table VI. In each case the mean scores were significantly different at the $p < 0.0005$ level of significance. The first hypothesis, therefore, has to be rejected. It has to be concluded, therefore, that the teaching of the module has in all probability led to this increase in scores

TABLE VII

A TABLE OF CLASS MEANS OF GAIN SCORES FOR EACH CLASS ARRANGED FOR ONE-WAY ANALYSIS OF VARIANCE WITH UNEQUAL n's

School	Grade	n	Mean Gains
Y	V	33	8.36
	VI	30	6.27
Z	V	27	15.82
	VI	34	12.71

Grand Mean = 10.67

TABLE VIII

A TABLE SHOWING THE RESULTS OF THE ONE-WAY ANALYSIS OF VARIANCE OF THE FIGURES IN TABLE VII

Source of Variation	df	MS	F	p
Between Groups	3	53.76	6.07	0.001
Within Groups	123	8.86		

TABLE IX

A TABLE OF MEAN GAIN SCORES AND RANGES OF GAIN SCORES OF STUDENTS IN SCHOOLS Y AND Z

SCHOOL	GRADE	n	MEAN GAIN SCORE	RANGE OF GAINS
Y	V	33*	8.36	-2 to 19
	VI	30*	6.27	-3 to 12
Z	V	27*	15.82	4 to 26
	VI	34*	12.71	3 to 27

* (Numbers include only those students taking both pre- and post-tests)

between the pre- and post-tests. It cannot be stated, however, that the module has definitely caused this increase, as other factors which may have caused the increase were not tested. A better research design for the experiment would be needed for this to be stated.

The second hypothesis was tested using a one-way analysis of variance test, the data for which are set up in Table VII. The results of this one-way analysis of variance are shown in Table VIII. There is a significant difference between the classes as to the mean increase in class scores between the pre- and post-tests. It is not possible at the present time to offer an explanation for the differences between class gains, but it is obvious that the reason behind the differences should be investigated in the future, as it does seem to cause such a difference in the amount of learning due to the module.

However the classes with the highest gains were both in the same school, (see Table IX) so it may be that it is not the difference between classes which should be investigated but the differences between schools. In this case the school with the better increases is a well-equipped urban school, whereas the school with the lowest recorded increases is a rural school in a small community. There may also be differences between the homes from which the students in the two schools came, which could account for the differences recorded.

Strangely enough, the best average gains were recorded for one of the Grade V classes, which also had the highest mean score on the pre-test. The teacher of this particular class said, however, that this

was an above-average class which was always keen and eager to learn, and this could be an explanation of their good performance.

The results also showed that some students achieved very large individual gains between the pre- and post-tests. Students in both classes in School Y recorded gains of 26 or more marks on the tests. As the tests were marked out of only 50, these gains are extraordinarily high.

However there were some cases of regression in the two classes of School Y, that is of students scoring less marks on the post-test than on the pre-test. One explanation offered by both teachers in this school was that some of the students had a reading level far below that of the grade they were in, and that their problem was one of not being able to read and understand the test questions. It may, in fact, be a major cause of the poorer results in these classes, and this may indicate that the test questions may need to be reworded for use with children of poor reading ability.

Even though the results shown in this section indicate that the module has been instrumental in causing an increase in scores between the pre- and post-test, a better study incorporating other variables such as reading level, type of school and socio-economic status of the parents needs to be carried out in future studies to ascertain whether or not it is the teaching of the module which is responsible for the increase in scores. This type of study should also attempt to answer the question as to why there is such a difference in gain scores between individual classes.

TABLE X

TABLE OF THE RESULTS OF THE ITEM ANALYSIS
OF THE POST-TEST QUESTIONS

ITEM	CORRECT ANSWERS	%	ITEM	CORRECT ANSWERS	%
1	19	67.9	17	22	78.6
2	22	78.6	18	26	92.9
3	16	57.1	19	16	57.1
4	22	78.6	20	26	92.9
5	19	67.9	21	24	85.7
6	5	17.9	22	26	92.9
7	27	96.4	23	17	60.7
8	25	89.2	24	14	50.0
9	24	85.7	25	15	53.6
10a	18	64.3	26	21	75.0
10b	27	96.4	27	14	50.0
10c	26	92.9	28	13	46.4
10d	16	57.1	29	23	82.1
11	14	50.0	30	18	64.3
12a	5	17.9	31	21	75.0
12b	8	28.6	32	15	53.8
13a	18	64.3	33	20	71.4
13b	18	64.3	34	18	64.3
14	13	46.4	35	10	35.7
15	19	67.9	36	3	10.7
16	25	89.3			

F. TEST ITEM ANALYSIS

After all the post-tests of the second field trial were marked, an item analysis was carried out on a sample of the papers to find out what percentage of students had correctly answered each question. The purpose of this analysis was to see whether or not any test item was too difficult and needed to be altered, and also to set norms for each item so that future classes' responses can be compared with this norm group. A random sample of 28 papers (20%) was selected from the 140 completed post-test papers. The results of this analysis are shown in Table X.

It is obvious that there are six items which had less than 50% of the students answering them correctly, namely, 12a, 12b, 14, 28, 35 and 36. With the exception of number 28, these items all had one thing in common, that is, each was marked out of 2 marks. What is recorded in the table is the number of students who achieved full marks on these questions. This does not mean that all the other students scored zero, as, in fact, many were awarded 1½ or 1 mark, which would still be a pass mark for that question. For this reason there appears to be no reason to change these items.

On the other hand, item 28 was a multiple choice question which had only one mark awarded to it. It appears to be a very straightforward question and does not appear to be difficult, and for this reason it should remain unchanged.

The results of the class with the best post-test results indicate that students can, in fact, answer the great majority of items, and that

none of the items causes any major difficulty. The test then appears to be a good one, and none of the items is really too difficult. However, as the previous section mentioned, some of the items may need to be reworded for use with classes having students of a low reading level.

As each of the items on the post-test tests the achievement of a particular performance behavioural objective (See Appendix E), it is possible to say that none of the objectives is too difficult to attain, and that, therefore, the behavioural objectives are all right in their present form. It is now possible to state these objectives in terms of the percentage of students in a class who should be able to achieve them, in future revisions of the module. This will allow teachers to compare the performance of their classes with those of the norm group used in the second field trial.

G. SUMMARY OF RESULTS

In this evaluation of the module and its teaching, six different types of evaluation were used. The "assessment by experts" approved the module in its written form, with a few minor revisions, for use in the first and second field trials.

During the teaching in the second field trial, the "Teacher Interview Schedules" developed during the first field trial were used to obtain information on individual lessons. This information showed that most of the lessons were quite all right in their present form, but that a few need minor revisions.

After the period of teaching, the opinions of students were canvassed in the "Student Opinion Questionnaires". It seems as if the

majority of students liked the course a lot, and had fun while learning. No major changes seem necessary to the module as no section of the module was disliked heavily. Most students said that all elementary schools should try the module.

The "Teacher Opinion Questionnaire" administered at the end of the module showed that the teachers were more than satisfied with the module and that they would use it again. Very few changes seem necessary as a result of the replies to the questionnaire.

The results from the pre- and post-tests were analysed to see whether or not the gains made by classes were statistically significant. The gains made by each class were significant at the $p < 0.001$ level of significance. This indicates that the module may have been responsible for the significant increase. However as the prime objective of the thesis was to develop the module, and not to test it rigorously under various conditions using proper experimental designs, other variables which might have accounted for the increases were not tested. These variables would include history, maturation and also the "Hawthorne" effect, as the students were aware of the experimental nature of the course they were pursuing. In order to specifically rule out the chance that other variables, and not the teaching of the module, were the cause of the increases, the module should be taught again to several equivalent classes using a research design in which other possible variables are controlled.

The results also showed a variation between classes as to the amount of gain between the pre- and post-tests, which was not readily

explainable from the test data. It has been suggested that in future field trials, such variables as reading level, school type and family background should be incorporated into any such experiment.

The post-test results were also used in a test-item analysis to find out if any of the test items was too difficult. With the possible exception of a few questions, students appeared not to have any major problems with items, and there appears no reason to change any of the questions. It may be necessary, however, to reword some of the items for use with students with low reading levels. The results were also used to draw up norm values for the attainment of each behavioural objective stated in the module, so that teachers using the module can compare the performance of their classes with those of the norm group.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

An environment education module for use in Newfoundland elementary schools has been developed and rewritten as a result of two sets of field trials involving three schools, six teachers and 191 students in the St. John's area.

Information about the success of the module has been obtained by the administration of various evaluation instruments. These included cognitive and attitude-to-environment tests, teacher interview schedules, as well as student and teacher opinion questionnaires.

The information has been tabulated and analysed in order to estimate the effectiveness of the module.

B. CONCLUSIONS

The major part of this dissertation is concerned with the initial evaluation of a specially produced module. How, then, is the success of the module to be evaluated? Various types of evaluative instrument have produced a large amount of information. The best way of making a decision about the effectiveness of the module is to refer to the original six problems to be investigated, as outlined in Chapter One, "Introduction". Each problem will be dealt with separately and answered using the collected information.

Problem 1 is the major problem of those under investigation

and can only be answered by reference to the answers given to the other five problems.

Problem 2

"To what extent will the module produce an increase in students' cognitive knowledge of the local environment?"

The information relative to this question is found in Chapter 4 under the heading, IV, "Cognitive Tests". The results show a statistically significant gain in knowledge between the pre- and post-tests, which is probably due to the module. The results indicated that the gains might also be educationally significant, although results varied between classes. However it should be remembered that the gains recorded may have been due to variables other than the teaching of the module (p. 73).

Problem 3

"To what extent will the module cause a measurable change in the attitude of students to their environment?"

As earlier explained in the section on evaluation in Chapter 3, it was not possible either to obtain or construct a valid and reliable attitude-measuring instrument which would allow changes in environmental attitude to be measured. It is not possible, therefore, at the present time, to state whether the module has been successful in causing a positive change in the attitude of the students to their environment. One suspects, however, that this might be the case, on reading some of the comments made on the student course opinion questionnaires. It is to be hoped that students have become more aware of their environment, and that attitudes

have changed, or will change, for the better. In order to answer this question a valid and reliable measure of attitude change will have to be constructed and administered in future field trials of the module.

Problem 4

"To what extent is the module suitable in its present form for both Grade V and VI classes? Should it be used at only one grade level; and does it need to be rewritten before further trials?"

The teachers using the module felt satisfied that the module was appropriate for the grade levels they taught, and two felt that it could even be used with above-average Grade IV classes and maybe with Grade VII as well. (See Chapter 4. "Results", Teacher Opinion Questionnaire). The results of the student opinion questionnaire indicated that students in Grades V and VI were more than satisfied with the course as they were taught it. The results of the student post-tests also indicated that students at both grade levels could learn a lot from the module. The module, therefore, appears suitable for Grades V and VI, and maybe also lower and higher grades, but this could only be stated with certainty after field trials with other such grades.

The replies to the Teacher Interview Schedules and the Teacher Opinion Questionnaires indicate that minor changes are necessary to the module before it is used in more schools. The actual changes necessary are outlined in Chapter 4, "Results", under the headings "Teacher Interview Schedules" and "Teacher Opinion Questionnaires". However, no major changes appear necessary, although the post-test may need re-wording to make sure that its reading level is appropriate to most students in

elementary grade levels.

Problem 5

"Is it possible to provide a written teachers' guide which any elementary school teacher can use, regardless of educational qualifications?"

Unfortunately, the five teachers who participated in the field trials were not wholly representative of all elementary teachers in the province. The teaching grade level of the teachers varied from IV to VI, the years of teaching experience from six to thirty-five years, and the number of science courses in University (Geology, Biology, Chemistry and Physics) from none to 10. (See Appendix B.2). The few teachers using the module were satisfied with the teachers' guide on the whole, although several minor revisions were suggested (see Chapter 4. "Results", Teacher Interview Schedules and Teacher Opinion Questionnaires). In order to answer the question fully, one would need to try out the Teachers' Guide with other teachers not represented in the small sample used in the present study. Teachers with teaching experience of less than six years, and teachers with teaching grades lower than IV would need to be consulted for their opinion of the module, especially the Teachers' Guide.

It does appear that even though the module is science-oriented, teachers with no science qualifications can use it successfully.

Problem 6

"To what extent do the teachers and students consider the module to be enjoyable, effective and useful?"

It seems obvious from an analysis of the results of the replies to the student opinion questionnaires (see Chapter 4. "Results") that the great majority of the students considered the course to be useful and

effective in the sense that they considered that they had learned a lot from it and stated that all elementary students should do the course. Personal observations by the developer and the other teachers involved in the module also suggested that the students enjoyed the course. Even other teachers in the schools, who were not themselves teaching the module, mentioned that their students seemed to enjoy it.

The student questionnaires seemed to suggest strongly that the students liked and enjoyed the module, and several even gave as a reason for other students' doing the course, the fact that it was fun to do the course and learn from it at the same time.

The teachers themselves appeared to enjoy teaching the module, from an analysis of their replies to the opinion questionnaire and from personal comments to the developer. The replies to the questionnaires and interview schedules also showed that the teachers considered the module to be both useful and effective, and this is borne out by the fact that all the participating teachers said they would teach the module again and recommended that other teachers should try out the module.

Now that answers have been proferred to the problems outlined above, enough information is available to answer the major problem.

Problem 1

"Can an environmentally-oriented module be developed which can be used successfully in Newfoundland elementary schools?"

It seems obvious that in the light of the answers to the other problems, such a module has been developed and used successfully. Of course the

question can only be fully answered when the module has been tried out in many more schools in the province, in urban and rural areas, as the three schools used in the field trials were in the St. John's area and cannot be said to be typical of all Newfoundland's elementary schools. It must also be tested again under more rigid conditions using a research design which effectively controls other variables which might conceivably have caused the cognitive gains observed in the initial evaluation.

RECOMMENDATIONS

The overall result of the testing of the field trials is that the teaching of the module was a success with the limited number of students and teachers who took part in the field trials. As a result of this study, several recommendations can be made concerning future use of the module.

1. The module should be rewritten in part to take account of the various suggestions made by teachers and students in the interview schedules and opinion questionnaires.
2. More reliable and valid evaluative instruments should be developed for use with the module, so that one can be more reasonably certain that students' scores on the post-test are accurate indicators of the fact that students have actually achieved the objectives of the module.
3. Of particular importance would be the development of a reliable and valid instrument for the measurement of the attitude of students to their environment. This would provide teachers with a better initial evaluation of student attitudes, and, as well, would allow researchers to find out whether the teaching of the module does indeed provide

a positive change in the attitude of students to their environment. In addition, the administering of such an attitude test would fulfill one of Rioux's (1973) suggestions that "research should be conducted on student attitudes toward the environment to provide baseline data for a retest in five years". (p. 52).

4. More schools and teachers should be encouraged to field-test the revised module to yield more data on the effectiveness and usefulness of the module. To give a more complete answer to Problem 1 (see Chapter I; "Introduction"), more schools outside St. John's and other urban areas would be required, and teachers with teaching qualifications lower than a Grade IV teaching certificate would be required, to give a better sample of the elementary schools, teachers and students found across the province.

5. In order to be certain that it is indeed the teaching of the module which causes cognitive gains, future field trials should be carried out using proper research designs for use with experimental settings. Factors which can alter the internal and external validity of such experimental testing should be adequately controlled in future evaluations of the module.

6. The problem of whether the present post-test is too difficult for students with lower reading levels than Grade V should also be investigated as it appears that many Grade V students have not attained a reading level of comparable status to the grade they are in. If necessary, the post-test should be re-written to accommodate a

greater range of student reading levels, or alternative forms of the post-test should be produced for use with different grade levels.

7. More visual materials (such as colour transparency slides) should be developed in line with teacher and student suggestions, and a list of helpful and readily available films and filmstrips, which could be used as supplementary materials for the module, should be produced.

8. If the revised module proves to be successful in a random sample of schools, which are more typical of those to be found in the province, the Provincial Department of Education should be requested to adopt the module for use in all elementary schools, and supply, free of charge, the module and materials necessary for its operation to all teachers requesting them.

9. Copies of the revised module should be addressed to the Federal Minister of the Environment, as an example of the type of material which can be developed in accordance with Rioux's suggestions, in the hope that a report of its use in this province might stimulate the production of similar modules in this and other provinces and territories of Canada.

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APPENDIX A

A LIST OF ENVIRONMENTAL EDUCATION ORGANIZATIONS RESPONDING TO REQUESTS FOR INFORMATION REGARDING THEIR PROGRAMS

U.S.A.

An Interdisciplinary Problem-Solving Approach in Environmental Education

Birks County Education Center
Nolde Forest State Park
Box 392, R.D. 1
Reading, Pa. 19601

Conservation Curriculum Improvement Project
South Carolina State Department of Education
Room 801, Rutledge Building
Columbia, South CArolina 29201

ECO Curriculum Development and Learning Laboratory
ECO Lab., R.R. 1, Box 550A
Laramie County School District #1
Cheyenne, Wyoming 82001

Environmental Education Demonstration Project
Instructional Resources Centre
1601 Van Buren Street
Topeka, Kansas 66612

Environmental Experiments Program
Information and Exhibits Division
Oak Ridge Associated Universities
P. O. Box 117, Oak Ridge Tennessee 37830

Environmental Studies Institute
Syracuse University
118 Clarendon Street
Syracuse, N.Y. 13210

Environmental Studies Program
Dartmouth College
Hanover, New Hampshire 03755

Environmental Studies Project
P. O. Box 1559
Boulder, Colorado 80303

Implementation of State of New Jersey Plan for Environmental Education

Outdoor Education Centre
New Jersey State College
Montclair, New Jersey 07046

Independence Outdoor Laboratory
Charlott-Mecklenburg Schools
P. O. Box 149
Charlotte, North Carolina 28201

Master Plan for Environmental Education in Milwaukee Public Schools
Environmental Education, Milwaukee Public Schools
P. O. Box Drawer 10K, Milwaukee, Wisconsin 53201

Model Education Program in Ecology
450 North Grand Avenue
Los Angeles, California 90012

National Environmental Education Development
Office of Environmental Interpretation
National Park Service, Washington, D.C. 20240

New York Youth Education in Conservation
Room 122, Education Building, S.U.N.Y. at Albany
1400 Washington Avenue
Albany, New York, 12203

Project CLEAN
Shawnee Mission Unified District #512
7235 Antioch Street
Shawnee Mission, Kansas 66204

Project I-C-E
1927 Main Street
Green Bay, Wisconsin 54301

Project CARE
Intermediate Unit of Montgomery County Schools
Court House
Norristown, Pa. 19404

Project SEE
School District of Wyandotte
Wyandotte, Michigan 48192

School/Community Environmental Studies Project
Carteret County Schools, P. O. Box Drawer 600
Beaufort, North Carolina 28516

Take a Look! Community Environmental Evaluation
Division of Adult Education
Box 3274, University Station
Laramie, Wyoming 82070

The Ethics of Environmental Concern Program
Social Studies Education
The Florida State University
Tallahassee, Florida 32303

Woodstock Environmental Education Project
Community Unit School District #200
Westwood School, 1424 South Street Road
Woodstock, Illinois 60098

2. CANADA

Learning About Environment
Robert F. Harrington and Richard C. Passmore
Canadian Wildlife Federation
Ottawa, Canada

Environmental Studies Series
Nova Scotia Museum
1747 Summer Street
Halifax, N.S.

The Guide to the Ecology Box
The Ontario Institute for Studies in Education
Toronto, Ontario

APPENDIX B

BACKGROUND INFORMATION

A DETAILS OF SCHOOLS INVOLVED IN FIELD TRIALS

1. FIELD TRIAL I (February - March, 1974)

School X (Metropolitan Area)

School Enrolment: 300

Classes used:

Grade VI 26 students (boys) taught by Author
Grade VI 24 students (boys) taught by Mr. G. Bambrick

2. FIELD TRIAL II (March - May, 1974)

School Y (City)

School Enrolment: 305

Classes used:

Grade V 33 students (mixed) taught by Mrs. E. Sparkes
Grade VI 36 students (mixed) taught by Mr. C. Rice

School Z (Rural)

School Enrolment: 255

Classes used:

Grade V 41 students (mixed) taught by Mr. P. Chalker
Grade VI 33 students (mixed) taught by Mr. T. King

B THE QUALIFICATIONS OF THE TEACHERS INVOLVED IN THE FIELD TRIALS

Teacher	Teaching Certificate	Yrs. Teaching Experience	Number of University Science Courses Successfully Completed
A	VI	9	10
B	VI	12	0
C	IV	35	0
D	IV	6	4
E	IV	11	2

APPENDIX C

THE MODULE (TEACHERS' GUIDE)

THE WINTER ENVIRONMENT

An Environmental Education Module

for Use in 6th Grade Classes

in Newfoundland Schools

INDEX

INTRODUCTION

A large number of people in Canada and in our own province have called for environmental education programmes to be introduced into our schools, to remedy the general lack of knowledge about our environment; in short to study our ecology.

This module is designed to introduce students to a better understanding of Newfoundland's winter environment. Included in the module are sections on each of the following:-

1. The Winter Climate - a brief look at winter in our province.

2. Wildlife in Winter - a look at what happens to wildlife as winter approaches; which animals are active in winter; what enables them to survive the rigors of winter; life-history of some animals.

3. Plants and Winter - what happens to plants on the approach of winter; which plants are active in winter; the uses of plants.

4. Summary - a summary of the ideas seen in the module; the meaning of and importance of ecology, environment and habitat.

Students will have the opportunity to study the animals and plants of their own school grounds, and their own gardens, and will be able to pursue an investigation into the ecology of one animal.

There will be plenty of time for discussion of various topics, and where possible students will parsue activities related to the topics covered.

SUGGESTIONS FOR USE

THE MODULE -

This module is designed for use with 5th and 6th grade classes. It is designed to last 15 periods of 45 minute duration (including the administration of the post-test). However you can select the particular activities you would like to try, if you do not want to spend as much time as the whole module takes. You can also expand the module to take more than the 15 periods, by adding your own material or incorporating the 'out of class' activities into the in-class lessons.

The module consists of two field trips into the school grounds and a number of in-class student activities requiring minimal materials.

PRETEST -

A pretest and a post-test are supplied to allow you to find out the amount of student learning during the module. The pretest does not have to be given if you do not wish to spend an extra period on its application. However, the pre-test can give you information on the amount of knowledge of your students which may enable you to save time later. If for instance, you find that all of your students answer the climate questions well, then there is no need for you to give the first 2 lessons on the climate.

STUDENT EVALUATION -

It is suggested throughout the module that students write up activities in their notebooks, to increase their skill and efficiency in scientific recording of experimental data. Too many students prefer to rely on their 'excellent' powers of memory, rather than spend the time and effort in recording the information in a written and permanent form. Because students will spend a great deal of time and effort in writing up materials it is suggested that they be rewarded for their efforts.

Hence the post-test should not be the only means of assessing the students, a share of the marks should also be given to the written work of students (say 50%).

If students are asked to do as homework some of the out-of-class activities, maybe marks should be assigned to these as well. The post-test by itself cannot test all the objectives of the module. Some of the objectives will, however, be carried out in the written work of students.

OUT OF CLASS ACTIVITIES

At the end of many of the lessons there are suggestions for activities which students can do outside class. These are optional and do not have to be covered. They could be used as homework assignments or left for students as optional items they might be interested in doing.

They may also be used to enlarge the module and used as extra class activities. You can of course add your own material to the course.

SCIENCE AND OTHER SCHOOL SUBJECTS

Although many teachers may consider this module as a part of a science course, there is no reason why any non-science teacher should not teach it. The module can also be used to add to other courses.

Much of the climatic material lends itself to mathematical treatment i.e. calculation of averages, graph construction. Many of the other activities could be used to gain averages of all the students' data.

Art and English also can benefit. Art can be encouraged with the reproduction of track drawings, plant and animal drawings, etc. Writing, especially the creative form, could be encouraged with the recording of experimental data, and the making up of say an essay on 'What We Saw on the Field Trip.'

LESSON COMPOSITION

Each lesson is laid out in the same way. Every lesson revolves around a particular problem which the lesson tries to solve. The problem can be given to students at the beginning of the class as a focal point. Then follow the specific objectives which the student should be able to achieve, and which are tested in the post-test (and the experimental write-ups).

Suggested lesson plans follow as to how the lesson may be conducted, and background information is given or referred to in the Appendices at the back of the booklet.

In some of the lessons a list of materials required is included. The list contains easily available things (salt, etc.) and some items which can be made. For more information on how to construct (or have students construct!) these pieces of equipment, see the appendix on models, etc. Most of the items (and the slides) are available on request from M.A.J. Collins, Department of Curriculum and Instruction, M.U.N.

At the end of the lesson is a list of suggestions for out-of-class activities.

GROUP ACTIVITIES

As most of the lessons revolve around group activities and group discussions, there has to be some means of group communicating information to each other. The best way of doing this is for the teacher to ask all the groups to read out their information at the end of the class for other students to copy down and use, or for the teacher to write all the results on the board. If several groups have different data for the same experiment, then the results could be averaged. Hopefully results from several groups on a particular experiment should be better than the results from just one group. The size of groups and the way in which they are chosen is left to the individual teacher to decide.

COURSE OUTLINE

PRETEST If used, administer before Lesson 1, preferably 1 week prior to the use of the module, to allow time for marking tests and making decisions about which parts of the module are to be used on the basis of the marks.

SECTION ONE 'The Winter Climate.'

Lesson 1. Winter Temperatures.
Lesson 2. Other Features of Winter Weathers.

SECTION TWO. 'Wildlife in Winter.'

Lesson 3. How Animals Prepare For Winter.
Lesson 4. Evidence of Animal Activity.
Lesson 5. Animal Field Trip.
Lesson 6. Identifying Animal Footprints.
Lesson 7. Interpreting Animal Tracks.
Lesson 8. Adaptations to Winter Life.

SECTION THREE 'Plants and Winter.'

Lesson 9. How Plants Prepare For Winter.
Lesson 10. Plant Field Trip.
Lesson 11. Plant Adaptations to Winter Life. A.
Lesson 12. Plant Adaptations to Winter Life. B.
Lesson 13. The Uses of Plants.

SECTION FOUR. 'Summary.'

Lesson 14. Summary of the Module and Definitions.

POST-TEST

MATERIALS REQUIRED

Lesson 2.	Sets of climatic information sheets (Appendix A) if necessary.
Lesson 3.	1 slide projector and screen 1 set of slides of Nfld. animals
Lesson 5.	Thermometers, metre rules
Lesson 6.	Sets of track cards (for students) 1 set of track cards (for teacher)
Lesson 8.	1 set of animal foot models trays (or baking tins), sand (or salt) pictures of weasel, ptarmigan and hare thermometers, trowel.
Lesson 10.	Thermometers, metre rule, trowels identification booklets (Newfoundland trees)
Lesson 11, 12.	Cardboard, hat pins (or toothpicks - plastic), scissors, scotch tape (or masking tape), washers (about 200 - 1"), plastic straw, electric fan, wooden mount and scale drawings of Nfld. leaves, foot rules.

SECTION ONE

"The Winter Climate"

LESSON 1.

PROBLEM. 'What are winter temperatures, and which months of the year are considered to be winter months.'

OBJECTIVES.

'From a given set of temperatures, the students should be able to choose those which occur during a Newfoundland winter.'

'From a given series of months students should be able to choose those months which normally make up a Newfoundland winter.'

SUGGESTED LESSON PLAN

1. Place sets of temperatures such as the following on the board and ask the students to form into groups to decide which of the temperatures would most likely be found during winter.

($-50^{\circ}F$, $-30^{\circ}F$, $-10^{\circ}F$, $0^{\circ}F$, $32^{\circ}F$, $65^{\circ}F$, $80^{\circ}F$).

Where else or in which other Newfoundland months might they find the other temperatures. Then ask the groups for their answers. A consensus of opinion should settle on $-10^{\circ}F$, $0^{\circ}F$, and $32^{\circ}F$. You could then discuss the minimum temperatures recorded for winter (see Appendix A).

2. Then give the groups the following average monthly temperatures to plot as graphs (?). Ask them to decide which months of the year they would label as being winter months and why. Each group could then be asked to read out their decisions.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
25	24	28	34	42	51	60	60	54	45	38	30

Opinion will range widely i.e. 'months with snow,' 'cold months,' etc. Probably the best definition would be months with an average temperature of less than freezing point (i.e. 32°), although this will vary from year to year.

OUT OF CLASS ACTIVITY -

In preparation for the next class you could ask the students to watch or listen to weather forecasts and reports to find out about other aspects of Newfoundland winters, and make a list of them in their note books, as below, or to simply record the weather details for a few days.

'What happens in winter?'

1. Temperatures less than 32°F.
2.
3.

or

'Today's weather report.' Date _____

1. Temperature 21°F
2. Winds 25-30 m.p.h.
3. 4" of snow

LESSON 2.

PROBLEM. 'What are the other features of a Newfoundland winter?'

OBJECTIVES'

'Students should be able to write down, in their own words a definition of winter, which includes references to temperature, day length, type of precipitation, wind strength and snowfall accumulation.'

SUGGESTED LESSON PLAN

There are various ways of achieving the objectives for this period.

1. You could give each group of students a copy of Appendix A and get them to graph some or all of the figures presented, or to average the winter readings for say wind strength, snowfall etc. to come up with the average wind strength or snowfall for winter.

2. Another way would be for groups to discuss the lists they made in their own time from last time's out-of-class activity and come up with a joint list of features. At the end of the class these lists could be discussed, to come up with the best definition(s).

At sometime during the period students should be asked to write down their own definition of winter in their books. Such a summary definition could be - 'That time of year (normally December to March) having freezing temperatures, short daylight hours, strong winds and precipitation as freezing rain or snow, etc.

OUT-OF-CLASS ACTIVITIES -

1. The students could be asked to make a chart of winter weather features, everyday, using weather report information, etc. An example of such a chart would be

FEATURES OF WINTER IN NEWFOUNDLAND

	Temperature	Snow (")	Rain (")	Wind	Day length	Pressure	etc.
Day 1							
2							

After a month of records, the charts could be discussed in class, or exhibited on the walls of the classroom.

2. Alternatively different groups could record temperatures, etc. for different parts of the island (Corner Brook, Wabush, etc.) and record them in their books or write them in each day on a specially prepared chart on the classroom wall.

3. If students possess thermometers (and barometers, etc.) at home they could make daily records and compare them with those of other students to show local variations in temperature, etc.

These are just some of the ideas for out-of-class activities. Some more enterprising students might even get information on the current winter from a meteorological station and compare this winter with the average winter.

SECTION TWO

'Wildlife in Winter'

LESSON 3

PROBLEM. 'What do animals do when winter approaches?'

OBJECTIVES.

1. The students should be able to make a list of the animals shown on slides and for each guess whether it prepares for winter by hibernating, migrating, growing thicker fur or dying.

2. The students should be able to carry out library research in their own time on one Newfoundland winter active animal, and to make a list of its winter food, enemies, environment, and any adaptations it possesses for surviving in winter.*

* To be done as homework.

SUGGESTED LESSON PLAN.

As many of the students are not familiar with most of our major animals it is probably best to show the slides to see how many of the animals they know. For each animal, the students should write down the correct name of the animal, and make a guess as to what the animal does when winter approaches, or write down the correct answers (see Appendix G) in the following table.

Animal's Name	What it does on the approach of winter

Alternatively if students are not given the correct answers as to what the animals do in winter, the homework exercise could be used for this purpose and when all the projects have been done, each student could tell the class the animal he worked on and how it prepares for winter. The rest of the class could then correct their original guesses.

Enclosed below for your use is a list of some of the animals and what they do.

1. MAMMALS

Hibernate. (Chipmunk, bat, bear - winter sleep).

Remain active and grow a thicker fur. (Lynx, fox, moose, caribou, rabbit, vole, shrew, beaver, otter, muskrat, weasel, mink)

2. BIRDS

Migrate. (Bald eagle, robin, ducks, etc.)
Remain active and grow more feathers. (Ptarmigan, chickadee, starling, owl)

3. FROGS (Hibernate under stones etc. and bottom of ponds).

4. INSECTS, etc. (Most die, surviving as eggs or pupae).

(See Appendices B & F for more detailed information).

MATERIALS REQUIRED.

Slide projector, screen, set of slides of Nfld. animals.

OUT-OF-CLASS ACTIVITIES. (for homework)

Each group or student should select one of the winter active mammals or birds, and find out more information about them and what they do in winter, e.g. (name, size, weight, colour, food, enemies, reproduction, area found in, winter activities).

These projects could be written, or if in pictorial form could be placed on the classroom wall for all to see. (see Appendix G for sources of information on local animals).

LESSON 4

PROBLEM 'How can you tell whether there are live animals around, when you can't even see them?'

OBJECTIVES.

'Students should be able to make a list of signs that are evidence of the presence of live animals as the result of group discussions.'

SUGGESTED LESSON PLAN.

Tell the students that next period they will be going on a field trip into the vicinity of the schoolgrounds. They should be told to bring warm clothes, cap, gloves and boots. They will need a note pad, pencil and ruler. During the trip they may happen to see live animals, but the chances of this are slim. They will therefore have to look for other evidence of animals. The chart that results from today's discussion will be the focus of the field trip.

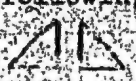
The students should discuss in groups, what would be evidence of animals, and make a list of their suggestions.

Each group can give a report of its findings at the end of the period. In preparation for the field trip the class should make a chart in their books incorporating the types of signs that groups have come up with, and space for any such signs they find on the field trip. The chart might be something like the one below.

Signs of animals	Description of signs	Identification of animal
A. Footprints		
B. Evidence of feeding		
C. Droppings		
D. Feathers or fur		
E. Etc.		

If animal prints are found on the trip then the description would be a drawing with measurements.

A short experiment you could try to convince students of the importance of 'written' records is this one. Divide the class into two's. While one member of each pair closes his eyes, draw the following sign on the board.



Tell the seeing partner to 'memorize' (but not draw) the sign. Erase the sign from the board. Now ask each 'seeing' partner to describe the sign to his 'blind' fellow. Then ask the 'blind' partners to reproduce the sign on a piece of paper, using only the verbal instructions of his partner. When all the drawings have been made, reproduce the original sign on the board. You can bet that the majority of the signs bear little resemblance to the original. It should convince students that memory and word of mouth are no substitutes for accurate drawings.

LESSON 5

PROBLEM. 'What signs of animal activity can you find in the schoolgrounds.'

OBJECTIVES.

'The students should be able to find, observe, measure and describe, in writing, any signs of animal activity.'

To make interpretations of the signs i.e. how and why they were made, and by what.'

SUGGESTED LESSON PLAN.

Take out all the students, or organize them into groups and send them to different parts of the schoolgrounds. (Or a nearby woodland or park). Look especially under stones or logs, by trees, sources of water, and garbage cans. (You could cheat a little by placing a source of food in an isolated area the night before to attract birds, cats, dogs, and mice).

Spend up to 30 minutes outside and then come inside and get the groups to complete the charts thar they began in Lesson 4.

Do not worry over the identification of tracks. This will be dealt with the next class. The importance of this class is the observing, measuring and describing of various animal signs.

MATERIALS REQUIRED

Thermometers, metre rule (for measuring snow depth), foot rules (for measuring tracks).

OUT-OF-CLASS ACTIVITIES

Students could search their own gardens for signs, and if accompanied, in the woods. In either case they should record what they see in the form of a chart such as the one below.

Date	Location	Type of Sign	Description	Animal

LESSON 6

PROBLEM 'What do the tracks of Newfoundland animals look like?'

OBJECTIVES

'Students should be able to identify from drawings the footprints of the more common animals especially cat, dog, fox, rabbit, moose, caribou, bear and weasel, and to describe their important characteristics.'

SUGGESTED LESSON PLAN.

Start off the lesson by holding up the track card of the moose. Ask what the animal that made the track was, and then the important features that make the track obvious. Then give each group 3 student track cards and ask them to guess which animals made the tracks, and to describe its identifying features. (i.e. size, footpads, claws, hooves, etc.). You can use all the cards or just those of more common animals. At the end of the period either ask groups to report on their guesses and descriptions or show your track cards and ask questions which will encourage students to identify the important features of each print.

MATERIALS REQUIRED

Sets of student track cards.
1 set of teacher track cards.

OUT-OF-CLASS ACTIVITIES

Students could make up track stories on sheets of paper. To do this they can use carrots or potatoes to form the impression of an animal's footprint.

Then placing the imprint on an ink pad they can make a series of tracks across a sheet of paper, and draw on some trees, a river or pond, etc. They could use several animal tracks to make a story for the rest of the class to interpret.

e.g. Fox comes out of hole, walks to river. On way back follows rabbit tracks to a hollowed log.

LESSON 7

PROBLEM. 'What was an animal doing when he made a series of tracks.'

OBJECTIVES.

'Students should be able to look at a series of tracks of an animal, and choose from a list of things, what the animal was doing at any point in the sequence i.e. walking, sitting, running, hopping, jumping or standing.'

SUGGESTED LESSON PLAN.

Probably the easiest way to start a study of a series of animal tracks is to start with a 2 legged animal, namely man!

If conditions permit, select 2 students and send them outside to an area of fresh (or raked) snow. One of them should then make a series of tracks in the snow, as read off a list by the other student. The list could be drawn up by you (i.e. 4 walking steps - 2 jumps - 3 one-leg hops, etc.). Then send out the rest of the class to record the prints, and measure the distances between prints. Inside the groups would interpret what was done at each instant.

At the end of the class read out your original instructions and see how close groups were. (As a competition each group could score 1 mark for each part of the series of tracks correctly identified!)

(If conditions do not allow you to try this activity you could draw up the prints overleaf as homework and discuss it the next period, and go on to Lesson 8).

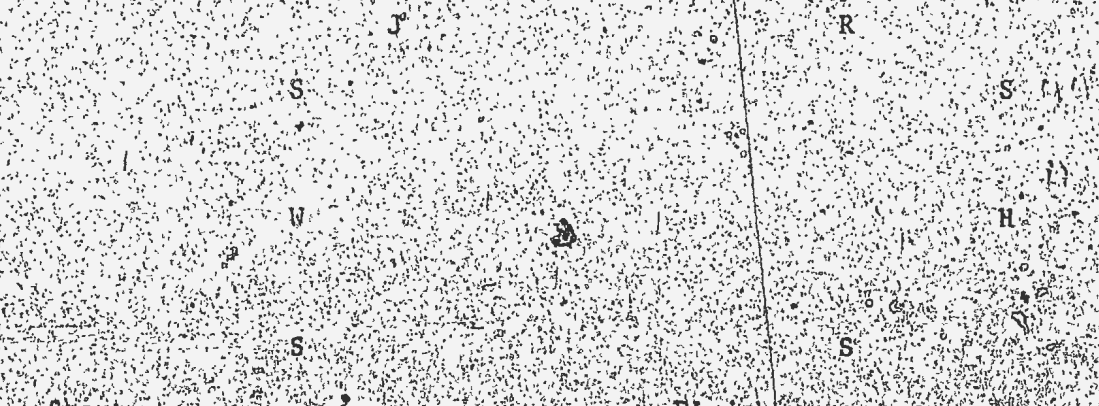
OUT-OF-CLASS ACTIVITIES

1. Pairs of students could test each other, by one making a set of tracks, and the other guessing, and vice-versa.

2. An alternative would be for students to find a series of dog, or cat tracks at home, to record them in their book, and interpret them. They might even use a pet animal to make a series of tracks for them.

SERIES OF TRACKS (of man)

- if you do not try activity.



Index S - standing H - hopping (on 1 leg)
W - walking R - running
J - jumping (2 legs)

LESSON 8 & 9

PROBLEM: 'What do animals do to survive the winter?'

OBJECTIVES:

'Students should be able to carry out the three activities in this lesson, record their data, and make written interpretations about the importance of coat colour change, snowshoe feet and living beneath the snow in winter.'

SUGGESTED LESSON PLANS:

There are 3 activities in this lesson, which will probably occupy 2 full class periods. The activities can be done in any order. Activity 2 is based on a series (6) of colour slides so it would be best to show all the slides to the class at the same time. Activity 3 will only work if the outside air temperature is less than 28. If the air is warmer, just give the students the data at the beginning of the activity, and allow them to work out an answer for themselves.

The method that the students should use to perform the activities are long and involved. It may therefore be best to read out the methods for the class to copy down in their books, or leave them written up on the board, or run off xerox copies for each group or even to demonstrate each activity to the class before the groups try the activities.

The students, as a minimum, should write down in their books the question for the activity, the results they obtain, and an answer to the question. For activities 1 and 3 it would be ideal to place the results from all the groups on the board, and then each student could place the class average results in his book, and use these to work out an answer.

ACTIVITY 1

QUESTION 'Which type of feet are best for walking on snow?'

METHOD You are provided with sets of model feet as listed below:

A.	Lynx foot (summer)	Lynx foot (winter)
B.	Fox foot (summer)	Fox foot (winter)
C.	Ptarmigan foot (summer)	Ptarmigan foot (winter)
D.	Rabbit foot (Nfld.)	Rabbit of same size, but where no snow.

Place about 2" depth of sand or salt in a tray or baking tin. Using both hands take one of the sets of model (i.e. fox - summer & winter) and press each model lightly into the sand. Which one sinks more easily? Now try the other pairs of models.

RESULTS List your observations as shown below.

Model	Which foot sinks easiest?	Which foot is hardest to sink?
Lynx	small	large

ANSWER Now answer the question.

ACTIVITY 2

QUESTION 'Why is it that some animals' coat colour changes in winter to white?'

METHOD Look at the photos provided of the rabbit (snowshoe hare), weasel (ermine) and ptarmigan in their summer and winter coats.

RESULTS Write down the colour of each animal's coat in summer and winter.

ANSWER Try to explain why these animals change their colour in winter. Consult encyclopoedias if you want.

ACTIVITY 3

(Teacher's note:

This experiment will only work if air temperature is well below 32°F.!)

If air temperature is 30°F or above supply students with these temperatures.

Air	20°F
Snow	32°F
Ground surface (beneath snow)	34°F

QUESTION 'Why is it that many small animals live beneath the snow cover in winter?'

METHOD Go outside with a trowel and a thermometer. First wave the thermometer around in the air. After 1 minute record the air temperature. Then push (carefully) the bulb of the thermometer into the snow. Record the temperature after 1 minute. Now scrape the snow away to reveal the ground surface. Place the thermometer on the ground and record the temperature after 1 minute.

RESULTS Record the 3 temperatures in your book.

ANSWER Now try to answer the question.

LESSON 10

PROBLEM 'How do plants prepare for winter?'

OBJECTIVES.

1. 'Students should be able to make a list of plants and describe how each prepares for winter, and how it is possible to decide whether or not a plant is active during winter.'

2. 'Students should be able to perform library research in their own time on one Newfoundland tree, and to make a list of where it normally grows, whether it is active in winter or not, the adaptations it has for surviving through winter, and its uses to animals as food, cover and shelter.'

* To be done as homework.

SUGGESTED LESSON PLAN

One way of approaching the lesson would be to ask groups to list plants that are alive in summer, and then list those that are actually active in winter. For each plant they could list what the plant does on the approach of winter.

[Most plants do one of the following:

1. Die, but produce seeds i.e. most weeds and annuals.
2. Lose their leaves i.e. deciduous trees and shrubs.
3. Die off above ground, but underground parts (e.g. bulbs) remain alive i.e. tulip, crocus, daffodil.
4. Remain active - i.e. conifers, grasses (some) mosses]

In preparation for next class's field trip in search of plants they could make a list of the different things to look for on the trip e.g.

Dead plant remains, leaves, seeds.
Underground bulbs.
Evergreen plants.
Deciduous trees & shrubs.

Then ask students how they would decide whether deciduous trees are actually alive in winter.

OUT-OF-CLASS ACTIVITIES (for homework)

As another optional activity each student or group could be asked to carry out an assignment into one type of tree (see Appendix C). Point to focus on would be - name, appearance, size, location, uses to animals (i.e. as food), uses to man, seed, buds, winter twigs, etc.

LESSON 11

PROBLEM 'What types of plants can we find in winter, and are they dead or alive?'

OBJECTIVES

'Students should be able to find, observe and record evidence of both dead and living plants.'

SUGGESTED LESSON PLAN

Proceed as you did on the field trip for animals. Observe the trees, noting whether they have leaves (take samples), berries, cones, and buds. Then look at the snow level for plants. Finally scrape clear some of the snow for evidence of plants alive beneath the snow. (Moss, some grasses, etc.), dead leaves and seeds. Some samples of buds and other plants if needed should be obtained by you, to prevent a wholesale onslaught on the plant life.

In the labs get all the groups to summarize information collected. Identification of trees and winter twigs can be made by using the book 'Newfoundland Trees' (see Appendix G).

OUT-OF-CLASS ACTIVITY

Students could follow up the field trip by making observations on the plants in their own gardens, and adding them to the list.

LESSON 12

PROBLEM 'Why do most trees lose their leaves in fall?'

OBJECTIVES

'Students should be able to perform the experiments using leaf models and record their data, and make interpretations about the best leaf shapes for winter active plants.'

SUGGESTED LESSON PLAN

The objectives are covered by 2 student activities concerning snow accumulation on leaves and the resistance offered to wind by different leaf shapes.

If the second activity might be dangerous to carry out with the electrical fan you have, you could do this experiment as a demonstration using the leaves made by groups.

Give each group different "leaves," and at the end of the experiment all the results can be put on the board for each student to copy down and use.

Now while one of the group holds the straw in place on the desk, place one washer over the hat pin. Continue adding washers one at a time until the straw collapses under the weight.

Repeat for the other leaf model.

RESULTS Write down in your book the names of the leaves you used and the number of washers needed to collapse the straw. Then copy down the results for the other leaf shapes from board.

ANSWER In this experiment the washers take the place of snow weight in winter. With this in mind answer the question.

ACTIVITY 2

QUESTION 'Which type of leaf would it be best for a tree to have in winter to avoid too much wind resistance?'

METHOD Using the leaf shapes you have just made straighten out the kinks in the straws. Remove the hat pin and pierce it through the straw level with the leaf at the end of the leaf stalk distance.

Cut off the rest of the straw about 2" from the pin.

Make certain that the leaf shape can swing freely on the pin. Now stick the pin into the wooden support in front of the fan, with the fan off. Switch on the fan, and read from the scale the highest number the straw reaches. The higher the number the more the leaf would be blown by the wind.

RESULTS Write down in your books the names of the leaves you used and the scale number they reached. Then copy from the board the results for leaves you did not test.

ANSWER Now presume that all these leaves were on trees in winter. What would happen to the tree in strong winds? Now answer the question.

LESSON 13

(This lesson is a short one, so you could extend the last experiment into this period).

PROBLEM 'In what ways do animals help plants?'

OBJECTIVES

'Students should be able to make a list of the usefulness of plants to winter-active animals.'

SUGGESTED LESSON PLAN

This could be quite a short lesson, allowing you to discuss the 'plant' projects that the students have produced from the end of lesson 10. The information gathered would also answer the objectives of this lesson.

In winter trees (especially evergreens) give shelter to larger animals from the elements. Most plants produce food for animals (bark, berries, seeds, cones, leaves, etc.), and maybe if students have done the animal projects from the end of lesson 3, they could supply information on the food of herbivorus (plant-eating) animals. Some larger animals can of course hide in and around shrubs and trees, and escape predators. Some birds and small mammals use trees as homes (nests and hollows).

The central idea of this lesson is for children to see the importance of plants to man and animals, and to realize that without them animals could not survive.

LESSON 14

PROBLEM 'What are "climate", "adaptation" and "environment"?'

OBJECTIVES

'Students should be able to discuss the meanings of climate, environment and adaptation and write down a definition of each in their own words.'

'Students should be able to make a written forecast of the likely effects on animals and plants of changes in climate, environment and adaptation."

SUGGESTED LESSON PLAN

This is really a summary lesson to pull the whole module together. We have used the concepts of environment, climate and adaptation without defining them in detail before. Maybe one could start the lesson by asking students to give definitions of the words, and then refine them and place refined definitions on the board.

1. Climate - characteriatic weather of an area (i.e. precipitation, temperature, etc.)

2. Environment - Everything that surrounds and affects a living organism.
(i.e. climate, soil, air, water, other plants, and animals).

3. Adaptation - something that an animal or plant possesses which helps it survive in a specific environment and climate. (i.e, snowshoe feet, needles of evergreens, etc.)

The module in fact started by looking at one environment (Newfoundland's) and established the particular climate of the area. Then the module focused on some of our native plants and animals and how they have managed to survive here (i.e. adapted) by having adaptations which are specific to our own area.

APPENDIX A

CLIMATIC INFORMATION

(Based on data from St. John's Airport).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1. TEMPERATURES - (°F)												
Max.	56	55	65	71	76	85	87	86	82	73	67	61
Min.	-10	-10	-5	7	20	26	34	37	30	22	14	1
Avr.	25	24	28	34	42	51	60	60	54	45	38	30
2. PRECIPITATION (")												
Rain-fall	2.7	2.9	2.6	3.0	3.5	3.5	3.3	4.5	4.4	5.3	5.6	4.0
Snow	31.0	34.0	27.0	14.0	4.0	Trace	0.0	0.0	Trace	1.0	7.0	26.0
*Total	5.7	6.2	5.2	4.5	3.9	3.5	3.3	4.5	4.4	5.5	6.4	6.6
3. SUNSHINE (hrs.)	57	75	93	116	152	176	212	176	149	117	59	53
4. WIND												
Speed (m.p.h.)	18.5	17.9	16.7	16.1	14.3	13.5	13.0	12.9	14.2	14.9	16.0	16.6
Dir-ection	W	W	W	SW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	W
5. RELATIVE HUMIDITY (%)	85	86	88	83	78	78	78	81	80	83	86	85
6. FOG (hrs.)	138	138	176	230	245	208	188	176	162	167	166	125
7. ATMOS-PHERIC PRESSURE (m.m.)	991	991	991	994	998	997	998	998	999	997	996	993

* One inch of rain = eleven of snow.

APPENDIX B

THE MAMMALS OF NEWFOUNDLAND

Indigenous:

Little Brown Bat, Myotis lucifugus lucifugus

Long-eared Bat, Myotis keenii septentxionalis

Black Bear, Ursus americanus hamiltoni

Marten, Martes americana atrata

Short-tailed Weasel, Mustala erminea richardsonii

Otter, Lutra canadensis degener

Red Fox, Vulpes fulva deletrix

Wolf, Canis lupus beothucus

Lynx, Lynx canadensis subsolanus

Beaver, Caster canadensus caecator

Meadow Mouse, Microtus pennsylvanicus terraenovae

Muskrat, Ondatra zibethic obscura

Arctic Hare, Lepus articus bangsii

Caribou, Rangifer caribou terraenovae

Accidentals:

Polar Bear, Thalarctos maritimus labradorensis

Arctic Fox, Alpoex lagopus ungava

Introduced:

Common Shrew, Sorex cinereus

Mink, Mustela vison

House Mouse, Mus musculus domesticus

Norway Rat, Rattus norvegicus

Eastern Chipmunk, Tamias striatus

Snowshoe Hare, Lepus americanus struthopus

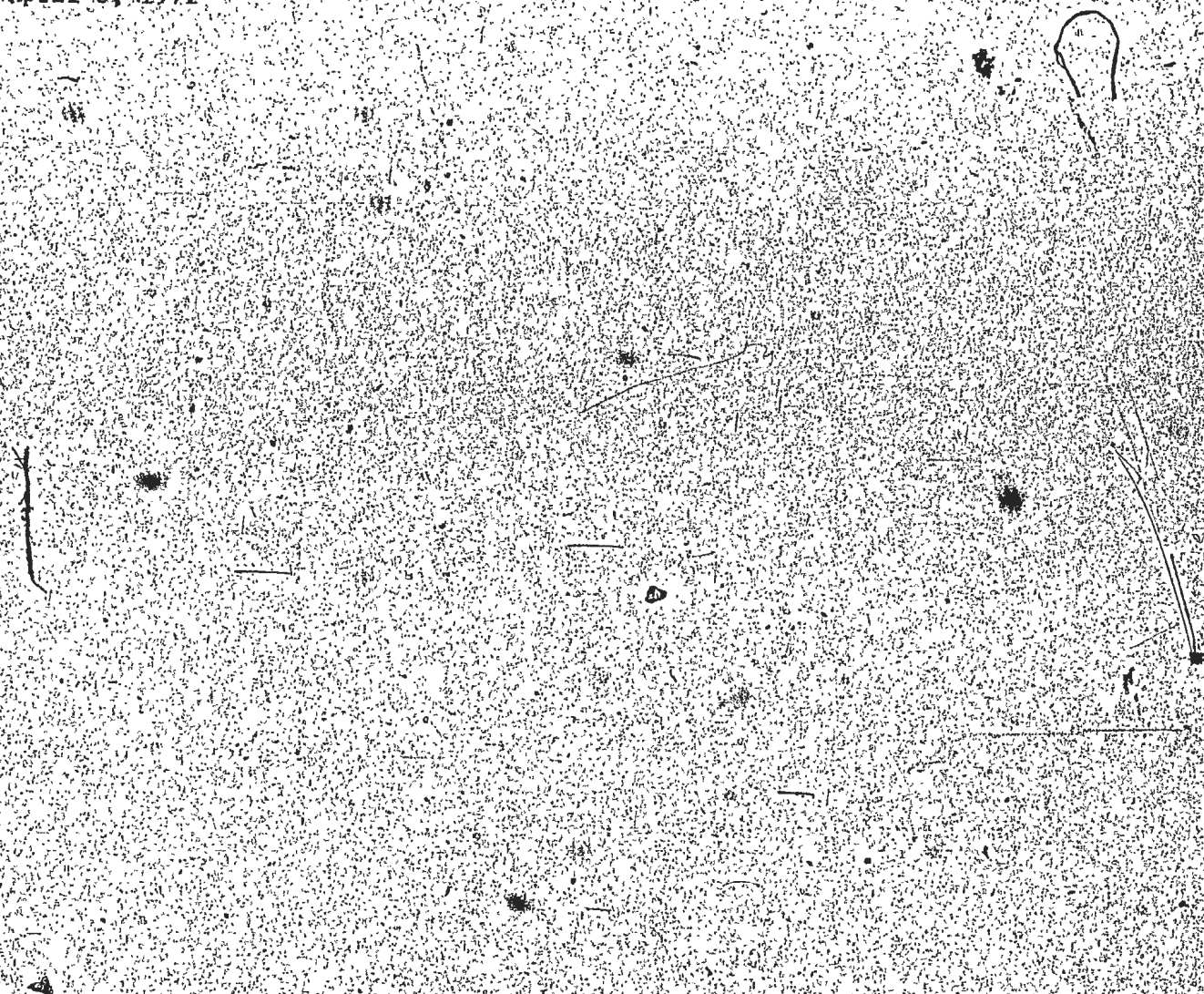
Moose, Alces alces americana

Buffalo (Bison), Bison bison

Red Squirrel, Tamiasciurus hudsonicus

* Extinct

April 6, 1971



APPENDIX C

TREES OF NEWFOUNDLAND

A. CONIFERS* (Evergreens)

- Balsam Fir (Abies balsamea)
- White Pine (Pinus strobus)
- Black Spruce (Picea mariana)
- Red Spruce (Picea rubens)
- White Spruce (Picea glauca)
- Tamarack (Larix laricina) - not evergreen
- Common Juniper (Juniperus communis)
- Creeping Juniper (Juniperus horizontalis)

*Active in winter

B. DECIDUOUS

- Pussy Willow (Salix discolor)
- American Mountain Ash (Sorbus americana)
- Balsam Poplar (Populus balsamifera)
- Shining Willow (Salix lucida)
- Choke Cherry (Prunus virginiana)
- Pin Cherry (Prunus pennsylvanica)
- Yellow Birch (Betula lutea)
- White Birch (Betula papyrifera)
- Swamp Birch (Betula pumila)
- Speckled Alder (Alnus rugosa)
- Dogwood (Cornus alternifolia)
- Witch Hazel (Hamamelis virginiana)
- Red Maple (Acer rubrum)
- Black Ash (Fraxinus nigra)
- Trembling Aspen (Populus tremuloides)

APPENDIX D

ANIMAL SNOW TRACKS

LARGE MAMMALS-

Moose

Fore and Hind

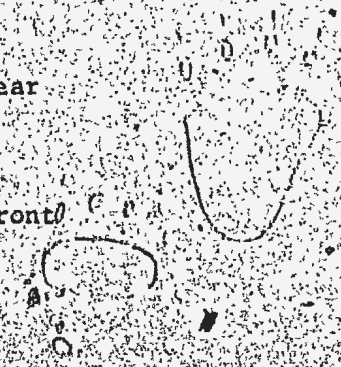
5"+

Bear

Front

Hind

7"



SMALLER MAMMALS

Lynx

Hard Snow

3½"

Soft Snow

7"

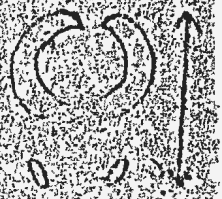
Cat (Smaller)

1½"

Caribou

3"

Fore and Hind



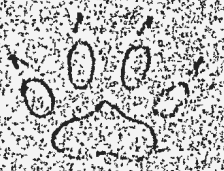
Fox

2"+

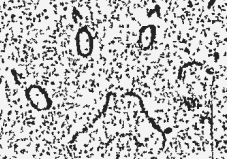
Tracks

Dog

Same but more irregular pattern of tracks than fox.



MARTEN, ERMINE, MINK,

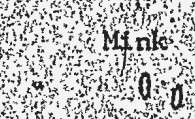


1½"

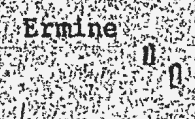
Also dive into and jump over snow.

Ermine 0.75"
Mink 1.25" (Marten rare)

Mink



Ermine



3"

or

Soft Snow

MUSKRAT

Showing tail drag

3"

Look for rush-house

Beaver

3-6"
Hind

Also wide flat
track of tail drag.
(Look for lodges, dam, bites, etc.)

Otter

3½"

Deep slides on
level or hilly snow
about 8" wide

OTHER MAMMALS

Hare (Artic) Very rare

5½"
Hind
Fore

Rabbit

(snowshoe)
Large feet.
5"
Hind
Look for rabbit scats.
Look for nipped twigs.

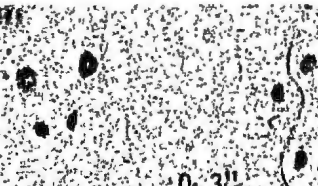
Tracks

SMALL MAMMALS

Rat

1"
3"

Shrew

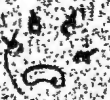


or 0.3"
5 toes
fore and rear
(Tail drag)

Chipmunk

fr.
1½"
hind

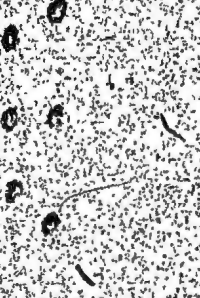
Vole
Similar to mouse



0.5"

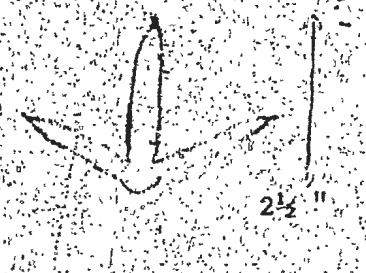
(5 toes on
hind foot)

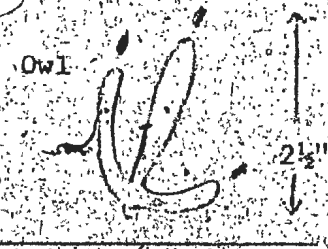
Several tracks



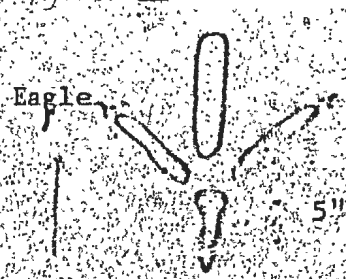
Also burrow under deep snow

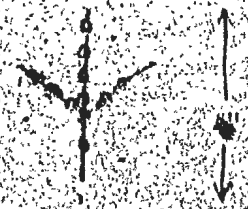
BIRDS -

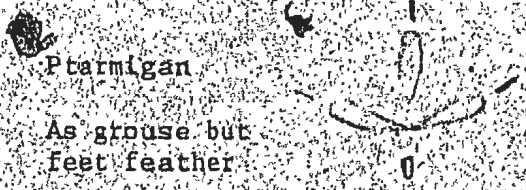




Duck - Smaller than goose







As grouse but feet feather

2"

Crow - 3"
Raven 4"

ECOLOGY 8

CLIMATE

M. Collins

It must be obvious to most people that the same types of animals and plants do not occur in all the countries of the world. Polar bears are only found naturally in the arctic, while elephants are only to be found in tropical areas. Why?

One of the main reasons animals and plants can only live in certain areas of the globe is the CLIMATE of the area, to which the animals and plants have become adapted over the course of time. The polar bear is adapted to the intense cold of the harsh arctic climate, the elephant to the warmth of the tropics.

As there are many types of climate, we will concentrate on our own Newfoundland climate.

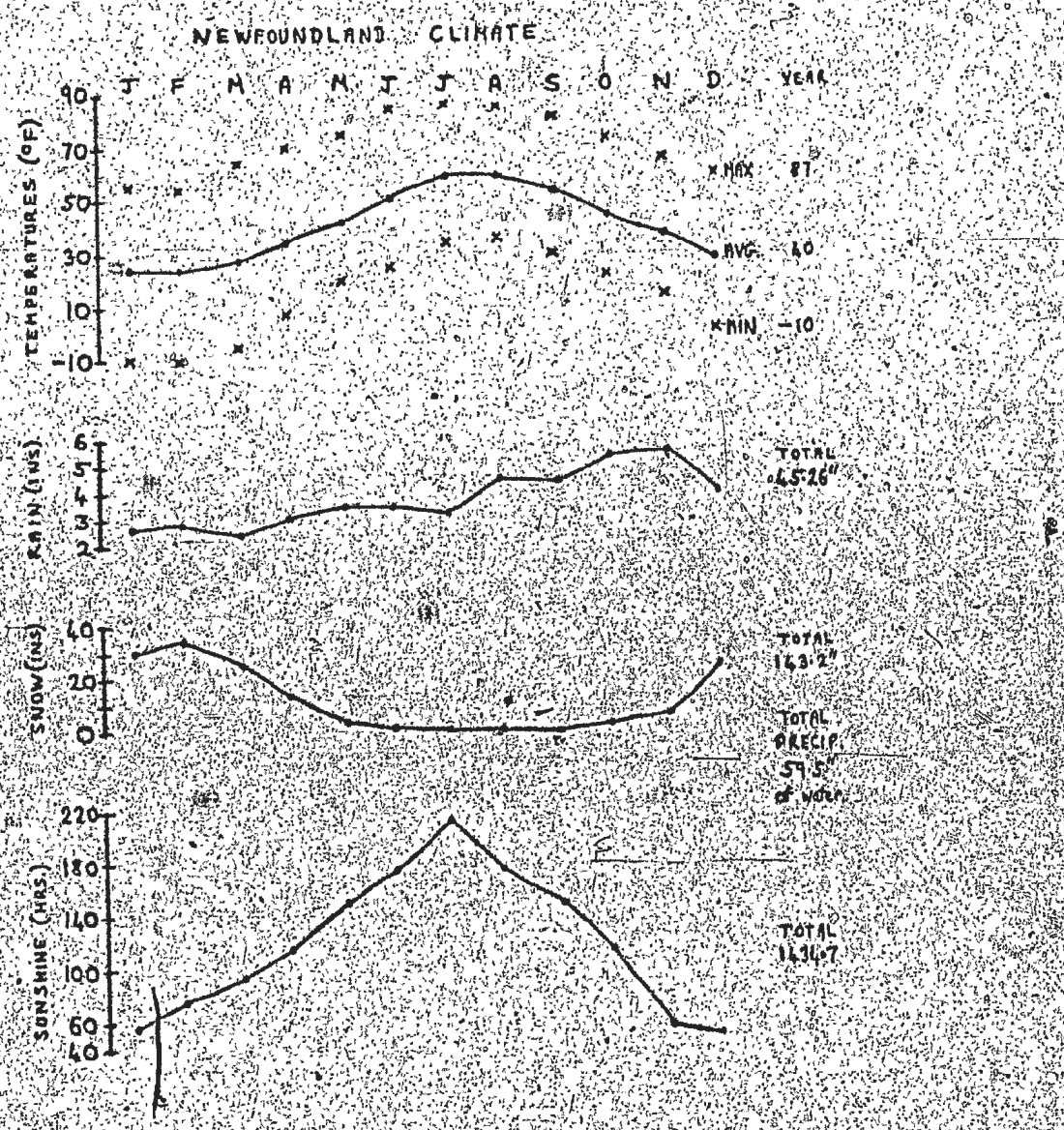
One of the most important aspects of a climate is the amount of sunshine, necessary for the photosynthesis of plants, and how it is distributed over the year. In our area we have 1434 hours of annual sunshine, not so much as the tropics, but most of it occurs in one season, summer, whereas in the tropics there is the same amount every day.

Another changing factor is temperature, not only the average temperature, but the annual range. Even though the average temperature here is 40°F, it varies from 87°F in summer, to -10°F in winter, and our animals and plants have to be adapted to both extremes.

The varying temperature and sunshine between them cause the rotating seasons - in our area, a long winter and summer, and two short seasons fall and spring.

Precipitation is a major feature of climate, not only the amount (60" here), but the types - rain, sleet and snow. All organisms need water, and especially tall trees. The weight of snow and sleet can crack limbs of weak trees, and small plants can be buried by snow.

In many parts of the world the relative humidity (dampness) of the air is important, but not here. In our area, the wind intensity is important (average 17 mph/day), as our trees have to be wind-resistant. Wind also causes, with relative humidity, a wind chill factor in winter, which considerably lowers the apparent temperature.



The graphs above were constructed from data obtained from the Atmospheric Environment Service at Torbay. You can make your own, if you wish, by obtaining local data from your local meteorological office.

ECOLOGY 9 THE BIOMES M. Collins

In the last month's article we saw that the climate is a major factor deciding the types of animals and plants living in a particular area. A large region whose climate produces a characteristic community of plants and animals is called a BIOME. We will now take a look at some of the biomes of Eastern North America, looking at their climate, other factors such as the type of soil, and their characteristic plants and animals.

The most northerly biome in North America is the POLAR biome, which has intensely cold weather, six months of darkness and six of light, and a permanent ice cover. Plant life is totally lacking, and the major land animals, Polar Bears, subsist on food such as Seals, taken from the Arctic Seas.

Further south we come to the TUNDRA, stretching across much of Northern Canada (including Northern Labrador). This is a vast treeless zone with a long and severe winter lasting around nine months or more, and a short summer where temperatures may not exceed 45^{0}F! Precipitation is small and plants obtain most of their water from melting snow. The deeper soil is permanently frozen, the PERMAFROST, limiting the depth of plant roots. Plant life is restricted to low growing plants which hug the ground out of reach of the cold winds, but even these do not form a complete ground cover. Mosses and lichens cover large areas, as do grasses and sedges. Woody plants such as the artic willow are only inches tall. Living off the producers are herbivores including the Tundra Vole, Lemming, Arctic Hare, Rock Ptarmigan, Barren Ground Caribou and the shaggy Musk Ox. Their predators include the Snowy Owl, Arctic Fox, Weasel and Arctic Wolf. In the short summer the many ponds of the region are host to many migratory birds.

Coming further south we enter the TAIGA or CONIFEROUS FOREST BIOME, which is characteristic of much of Canada including Southern Labrador and insular Newfoundland. This area has a milder climate with hotter summers and shorter winters, and greater precipitation. The soil here is not permanently frozen, and tends to be acidic. The biome is characterized by coniferous trees such as Balsam Fir, Black Spruce and Tamarack, and some deciduous trees, such as the Aspen, Birch and Alder. In the more open areas are shrubs such as

Blueberry and Labrador Tea. The herbivores are numerous including Moose, Woodland Caribou, Snowshoe Rabbit, Chipmunks, Meadow Mouse, and Grouse. This is also the area of the Black Bear and Beaver. The Lynx, Red Fox, Ermine, Marten and Boreal Owl number among the predators.

Further south in Southern Ontario and New England we encounter the DECIDUOUS FOREST BIOME with its four definite seasons, mild winters and less acid soils. The dominant trees are deciduous such as the Oak, Maple and Hickory, and the animals include Deer, Mice, Squirrels and White Tailed Deer, various Snakes and the Long Tailed Weasel.

For further information the following films available from NFB, Pleasantville, St. John's are very good:

'HIGH ARCTIC: LIFE ON THE LAND' (Tundra)

'THE CHANGING FOREST' (Deciduous)

and from Division of Instruction, Department of Education, Confederation Building, St. John's

'LIFE IN THE DECIDUOUS FOREST'.

II. ADAPTATIONS

In a previous article it was mentioned that we would not expect to find Polar Bears surviving in the Tropics, nor an elephant at the North Pole. But why not?

Every animal has evolved to its present state over a period of perhaps, millions of years, and now fits in perfectly with its environment, and particularly the climate. The polar bear has evolved to survive the rigors of the extreme polar climate, while the elephant can survive in the hot tropical areas. We can say then that each of these animals is uniquely adapted to its own environment, and each possesses adaptations which enable each to survive in their own areas.

An adaptation may be defined as 'any feature of an organism that aids it to survive and reproduce in the environment it inhabits.' To illustrate this definition let us look briefly at two of our Newfoundland animals and how they are adapted to winters in the Taiga Biome.

Both the snowshoe rabbit and its predator, the lynx, are well adapted to our winter climate. As winter approaches the rabbit's coat becomes white and much thicker. The change in colour is for camouflage from its enemies, and the thicker coat is for protection from the cold. The very large spreading feet of the rabbit act as excellent snowshoes to prevent the animal sinking into the snow when running over it. The lynx also grows a thicker coat in winter, and as winter approaches fur grows on the bottom of its feet to enlarge the foot surface, to enable the feet to act as snowshoes in winter to aid the easier hunting of prey. These then are just some of the adaptations of the rabbit and lynx.

Adaptations can be categorized as one of 4 major types. Firstly, there are protective colouration adaptations as seen in the rabbit, and also the ermine and ptarmigan. Secondly there are structural adaptations such as thicker fur, and snowshoe feet. Ptarmigans also have snowshoe feet. There are also physiological (or internal body) adaptations which are very common in hibernating animals which lower their body temperatures and cut down many of their normal body functions. Not many of our animals do in fact hibernate, besides frogs and chipmunks.

Another important type of adaptation is the behavioural type, in which the organism changes its behaviour to fit in with the environment. This is common among many of our animals. Small mice and shrews remain active below the snow in winter tunnels to keep warm and escape predators. Moose and caribou tend to move to wooded areas in winter to escape winter winds. Water animals such as the beaver and muskrat store up plant food in their native ponds in late summer, and then during winter stay in their homes in the pond and only come out to feed on their stockpiles, but always remain under the ice surface.

Adaptations are not restricted to animals alone. Many of our trees lose their leaves in fall and remain sessile in the cold winters, leaving the evergreens to remain active. Most smaller plants die on the approach of winter leaving their seeds to survive and grow during the next spring. If animals and plants were not adapted to their environments they would soon vanish from the face of the earth.

APPENDIX F

NEWFOUNDLAND'S MAMMALS AND WINTER

Masked Shrew - Active in winter, in tunnels beneath snow.
Meadow Mouse - Active in winter, in tunnels beneath snow.
House Mouse - Active in winter, around human habitation.
Norway Rat - Active in winter, around human habitation.

Newfoundland Muskrat - Active in winter in ponds beneath ice. Stores plant food for winter in ponds.
Beaver - Active in winter under pond ice feeding on winter store of tree branches, and staying in beaver lodge.

Otter - Active in winter above and below pond ice.
Weasel (Ermine) - Changes coat colour from brown to white. Active all winter above snow.
Mink - Active all winter above snow.

Rabbit - Coat colour changes from brown to white. Has large 'snowshoe' feet to run easily over snow.

Fox - Active all winter above snow.
Lynx - Develops furry feet for winter to act as snowshoes.
Bear - Semi-active in winter. Often sleeps for days.

Moose - Active all winter in wooded areas.
Caribou - Herd together for warmth in woods in winter.
Spreads its hooves and dewclaws in snow to act as snowshoes.
Bison - Active in winter. (Only on one South Coast Island).
Chipmunk - Hibernates. Rare.
Squirrel - Stores up food for winter. Active all winter. Rare.

Marten - Active in winter but rare.
Arctic Hare - Active in winter but rare.

Polar Bear - Permanently white. Winter visitor only.
Arctic Fox - Permanently white. Winter visitor only.

APPENDIX G

USEFUL ADDRESSES FOR FREE MATERIALS

1. Provincial Parks Division

Newfoundland Department of Tourism, (1045, Pleasantville)
P.O. Box 9340, Postal Station B, St. John's (Tel. 726-7892)
For free Park Interpretation Publications, especially # 11.
'Animal Tracks of Insular Newfoundland.'
(Also for guided tours and talks.)

2. Provincial Wildlife Service

Building 810, Pleasantville, St. John's (Tel. 726-0660).
For free information on most of our mammals and game birds.
They have a series of information sheets on our animals, and
will release in the future a booklet on the Mammals of Newfoundland.
(Also for talks to schools.)

3. Provincial Mines, Agriculture & Resources

Confederation Building, St. John's, (Tel. 722-0711).
For free booklet entitled 'Native Trees of Nfld. & Labrador.'

4. Canadian Wildlife Service.

Department of Indian and Northern Affairs, Ottawa, Ontario.
For free pamphlets on wild animals (advertised on T.V. as 'Hinterland
Who's Who?) Series on moose, bear, loon, etc.

5. Atmospheric Environment Service

St. John's, Airport, St. John's. (Tel. 722-2815) (or local weather office).
For Annual Meteorological Summary 1973/with long term records for 1942-73.

6. Fishery Service

Sir Humphrey Gilbert Building, Duckworth Street, St. John's (726-1993)
For free information on fish.

7. Terra Nova National Park

For small booklets on Beaver, Lynx, Moose, Hare, etc.

8. Canadian Forestry Service

304, Pleasantville, St. John's (726-7330)
For information on Trees and Shrew.

MODULE MATERIALS

A. 1 set of Newfoundland animal colour slides with list of same and what they do in winter.

B. 1 set of Track Cards (for teacher) and sets for students.

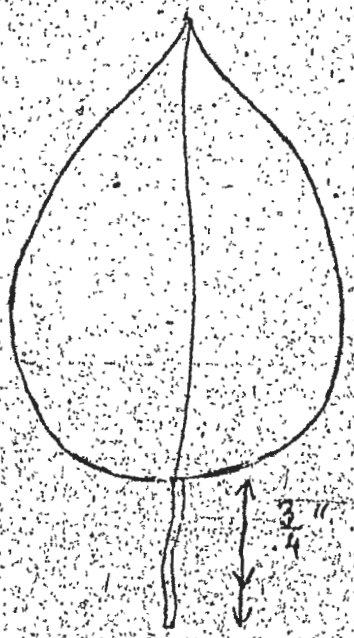
C. 1 set of instructions for construction of animal feet models.

D. 1 set of slides of 3 Newfoundland animals in summer and winter.

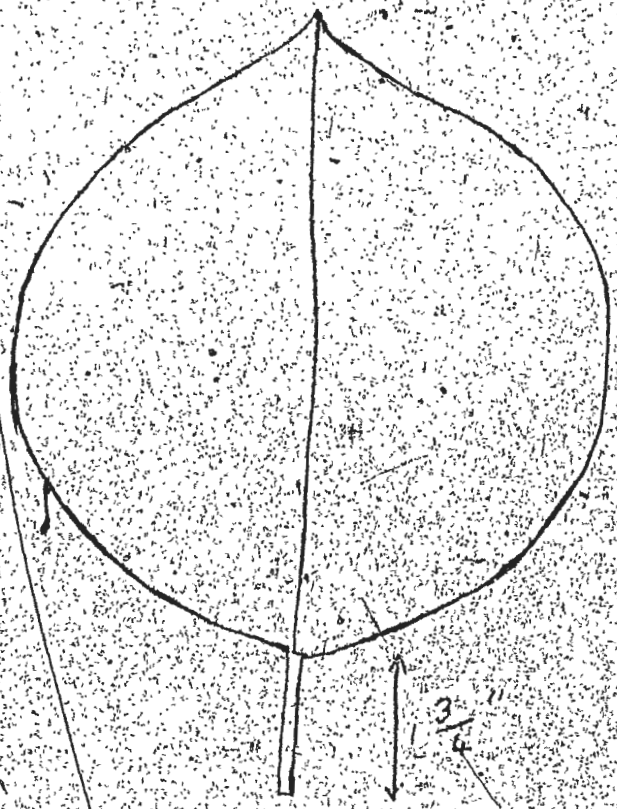
E. 1 set of full-size drawings of leaves of common Newfoundland Trees.

NEWFOUNDLAND LEAF TYPES.

A. BIRCH -

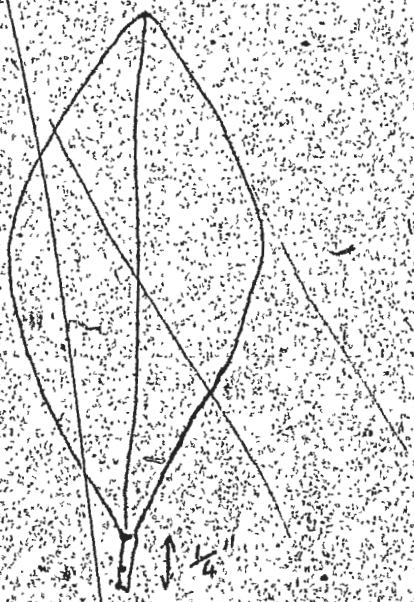


B. ALDER -

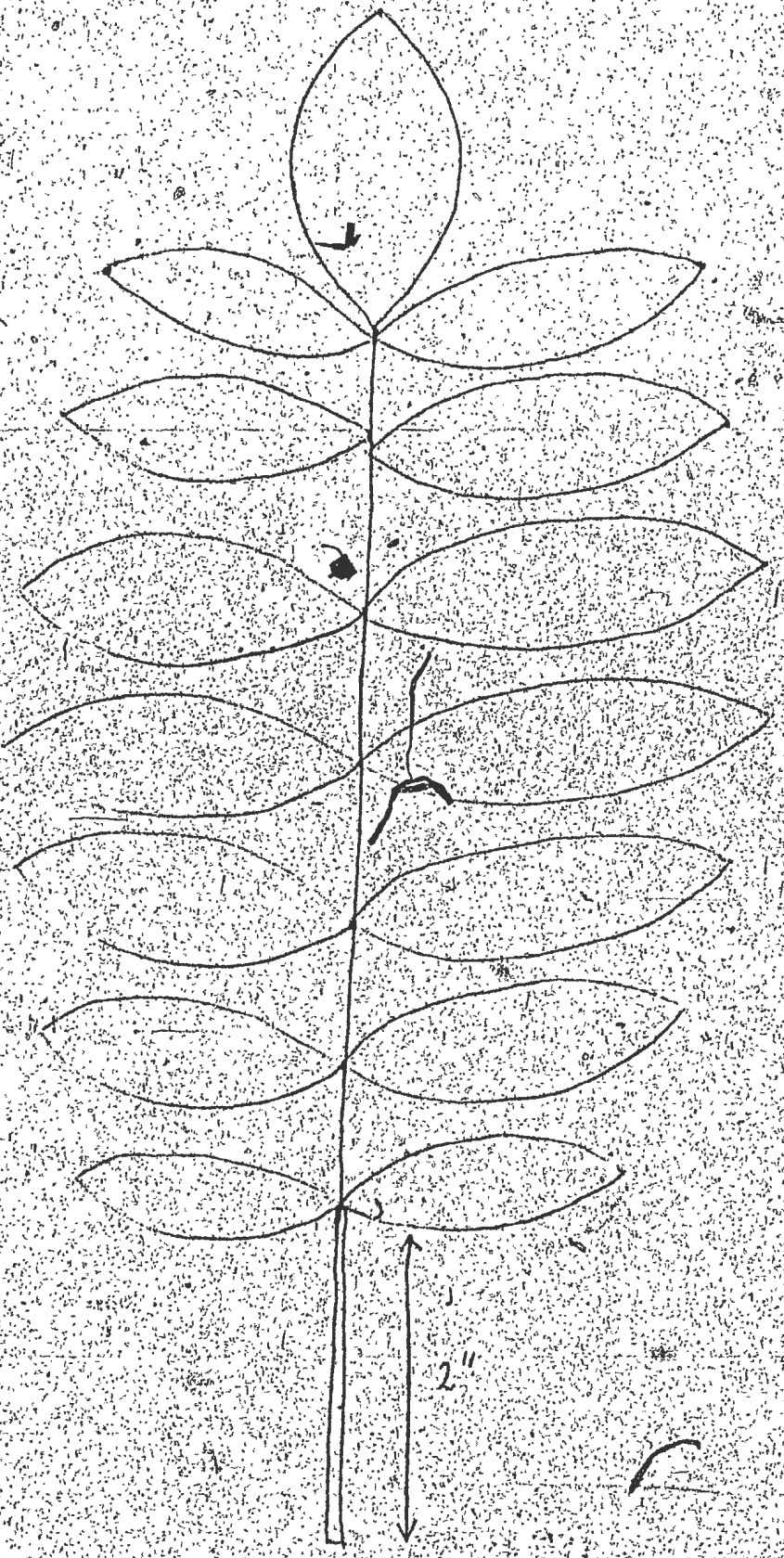


C. WILLOW -

D. CHERRY -



E. MOUNTAIN ASH -



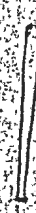
F. SYCAMORE MAPLE

2 1/4"

G. BLACK SPRUCE

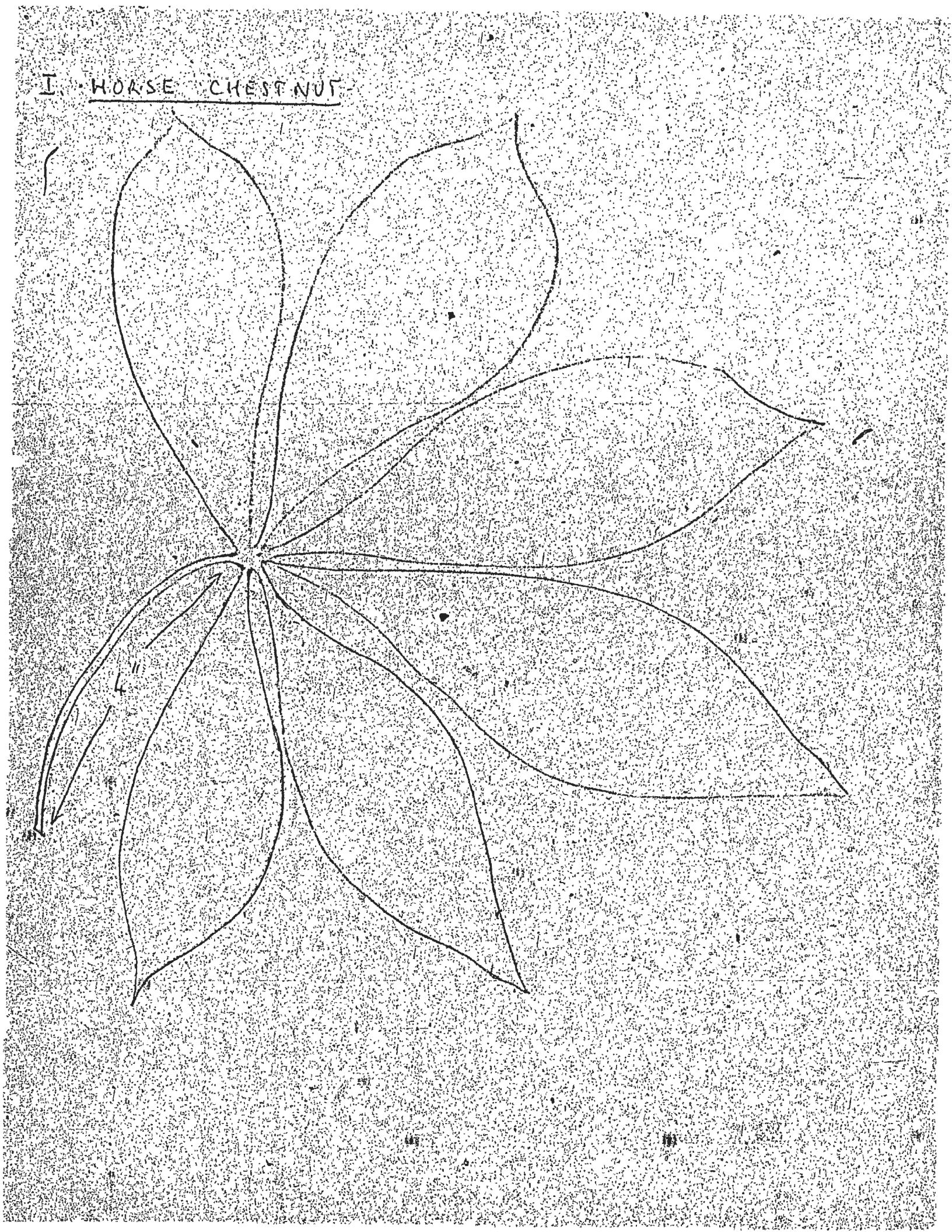
No stalk

H. BALSAM FIR



No stalk

I. HORSE CHESTNUT

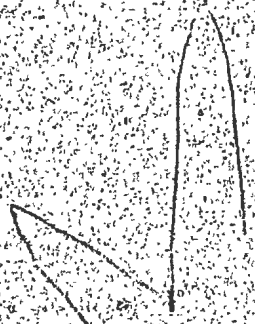


ANIMAL FOOTPRINT MODELS

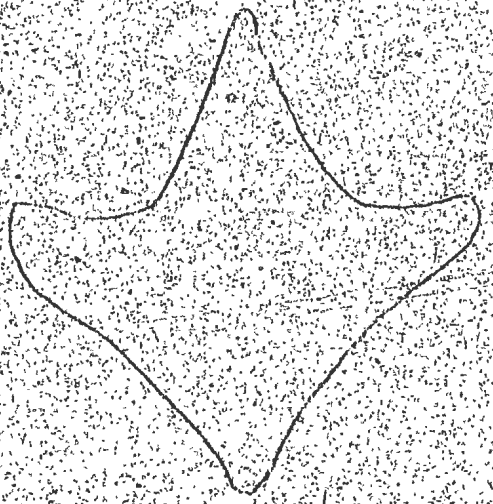
Cut out models from masonite or ¼" plywood. Mount feet on 3" lengths of $^{9}/_{10}$" x $^{5}/_{8}$" wood.

THE MODELS (Natural Size)

PTARMIGAN



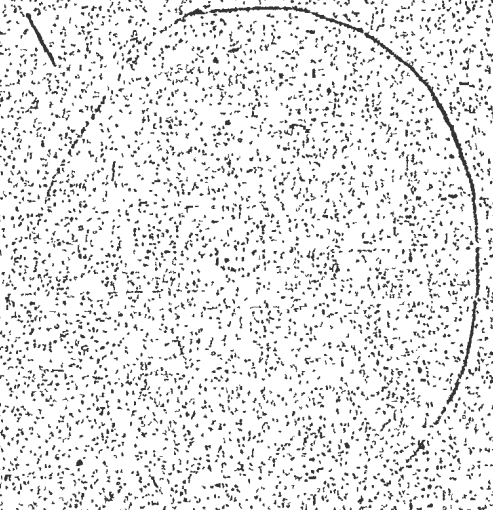
Summer



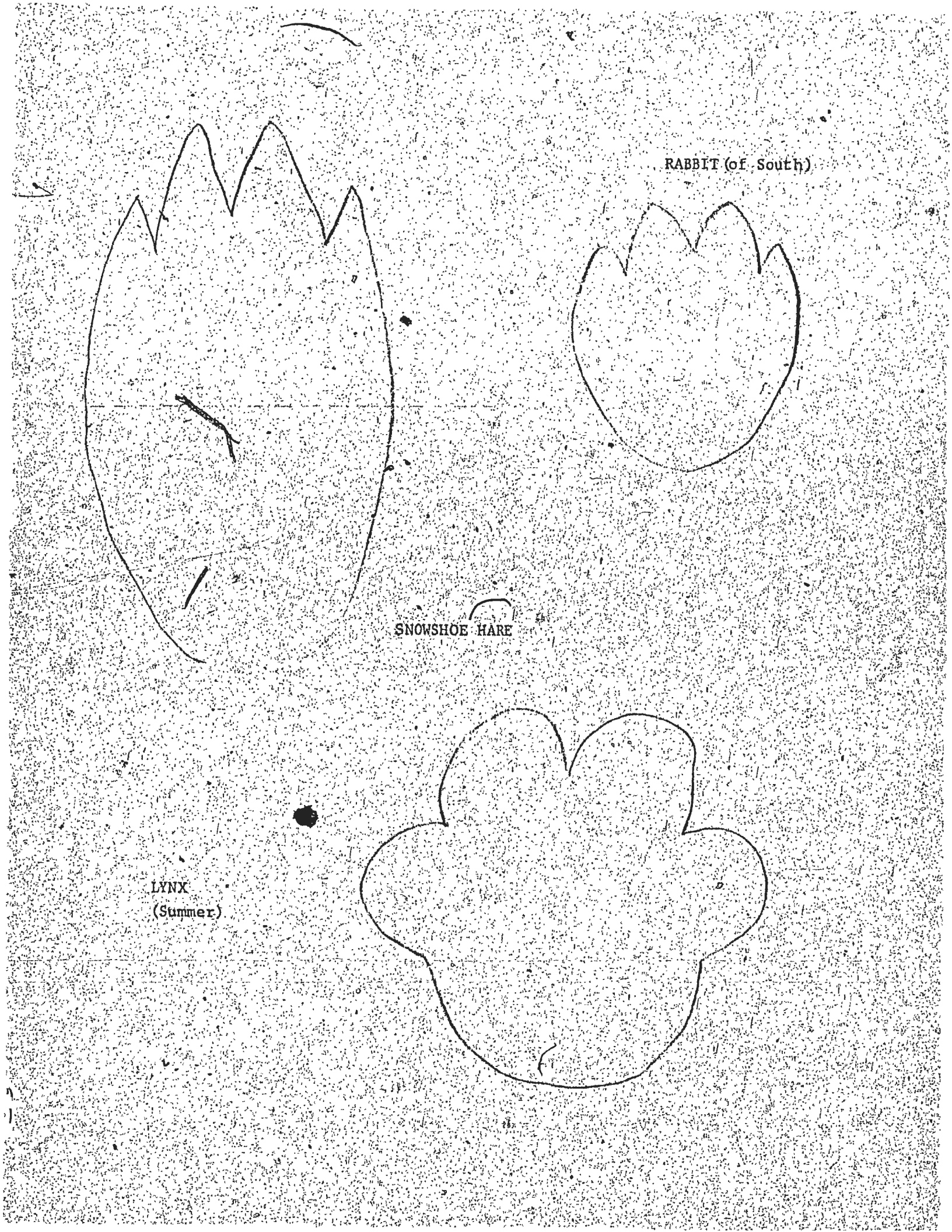
Winter

FOX

Summer

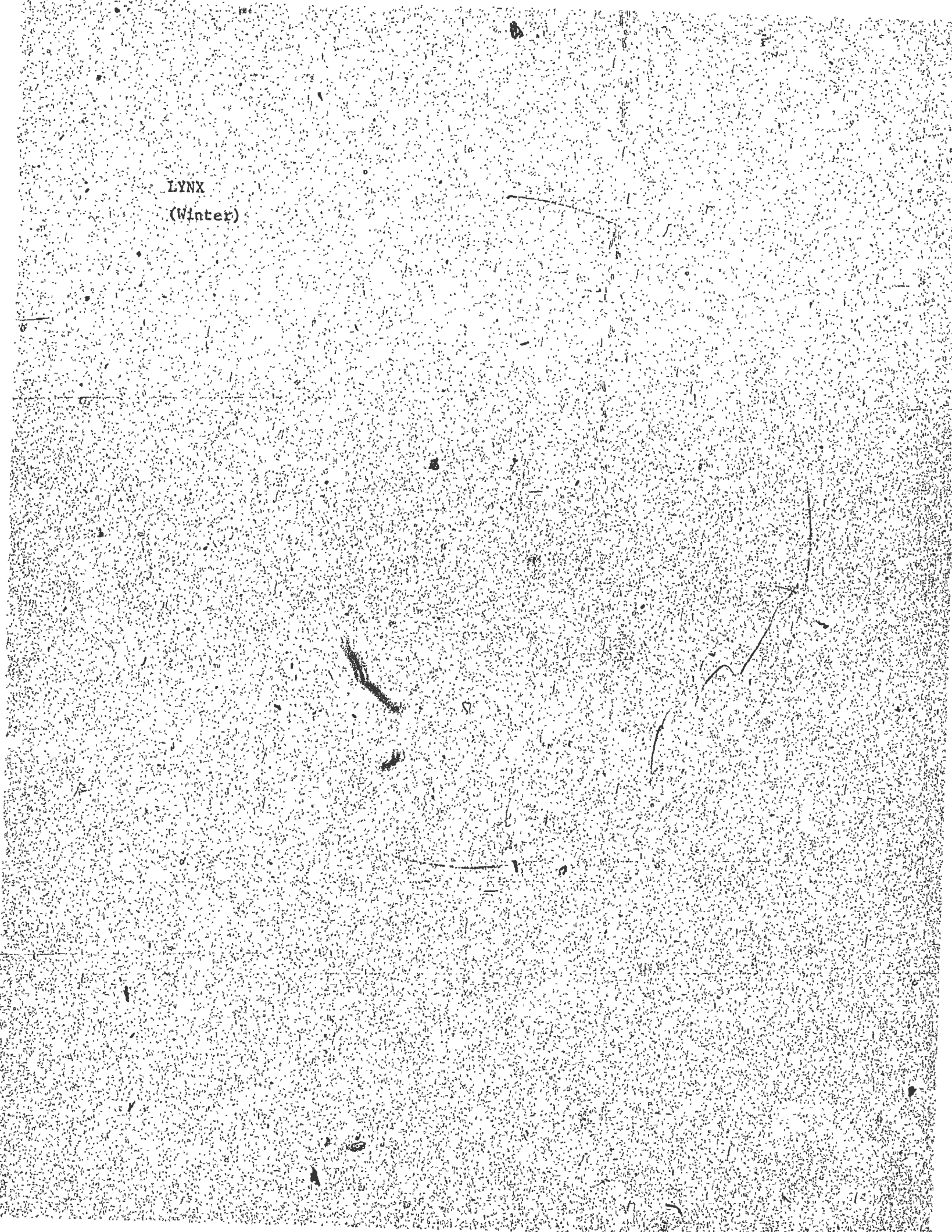


Winter


RABBIT (of South)
SNOWSHOE HARE
LYNX
(Summer)

LYNX

(Winter)



SLIDES OF NEWFOUNDLAND ANIMALS (LESSON 3)

(15-21 Not essential, if you want to save time)

MAMMALS - (Common)		
1.	Moose	Active in Winter
2.	Woodland Caribou	Active in Winter
3.	Black Bear - Sleeps for long periods	Active on occasions
4.	Lynx	Active in Winter
5.	Red Fox	Active in Winter
6.	River Otter	Active in Winter
7.	Beaver	Active in Winter, beneath ice.
8.	Mink	Active in Winter
9.	Weasel (or Ermine)	Active in Winter
10.	Newfoundland Muskrat	Active in Winter, beneath ice.
11.	Meadow Vole (or Field Mouse)	Active beneath snow
12.	Masked Shrew	Active beneath snow
13.	Bat	Hibernates
14.	Rabbit (or Snowshoe Hare)	Active in Winter
MAMMALS - (Rare and Visitors)		
15.	Newfoundland Pine Marten	Active in Winter (Rare)
[16.	Artic Hare	Active in Winter (Rare)]
[17.	Bison (or Buffalo)	Active in Winter (Rare)]
18.	Striped Chipmunk	Hibernates (Uncommon)
19.	Red Squirrel	Active in Winter (Rare)
20.	Polar Bear	Winter Visitor from Labrador
21.	Arctic Fox	Winter Visitor from Labrador
BIRDS		
22.	Osprey (or Fish Eagle)	Migrates south
23.	Owl	Active in Winter
24.	Crossbill	Active in Winter
25.	Herring-Gull	Active in Winter
26.	Ptarmigan (or Partridge)	Active in Winter
27.	Ducks	Migrate south
AMPHIBIANS		
28.	Frog	Hibernates at bottom of pond
INSECTS		
29.	Butterfly	Dies (survives as pupa, chrysalis)

APPENDIX D

EVALUATION INSTRUMENTS

1. WINTER ENVIRONMENT TEST

1. Choose the best description of a Newfoundland Winter month

   a. average temperature less than 65°F
   b. average temperatures less than 32°F
   c. average temperatures less than 0°F
   d. average temperatures more than 32°F

2. Which of these 4 sets of temperatures would not occur in Winter in Newfoundland?

   a. -20, -5, 10° F
   b. 0, 10, 30° F
   c. 10, 30, 50° F
   d. 50, 60, 70° F

3. Which month would most likely have a temperature of -10° F?

   a. March
   b. February
   c. November
   d. October

4. Which month normally has the shortest amount of sunlight?

   a. November
   b. December
   c. May
   d. September

5. Which month is most likely to have a total snowfall of 30"?

   a. November
   b. January
   c. April
   d. October

6. Write down 4 points which describe accurately the more important features of the Newfoundland winter weather

   a. _____
   _____
   _____

7. Most mammals prepare for winter by

   a. Not eating anything
   b. Growing a heavy coat of fur
   c. Migrating
   d. Shedding their fur

8. What do many birds do as winter approaches?

a. Lose their feathers
b. Hibernate
c. Migrate
d. stop eating

9. Which of these animals does not hibernate?

a. Frog
b. Chipmunk
c. Snowshoe Hare
d. Bat

10. Select from the list of animals below (Fox, Hare, Butterfly, Canada Goose, Bat, Moose, Partridge, Grasshopper, Robin, Chipmunk) or use other examples

a. Two that MIGRATE _____
b. Two which DIE on the approach of winter _____
c. Two which remain ACTIVE in winter _____
d. Two which HIBERNATE _____

11. There are many ways of telling whether live animals are present in an area, such as the presence of footprints. Name four other signs or traces of animal activity.

a. _____ b. _____

c. _____ d. _____

12. Choose from the list below, the animals that would make the prints a and b. Also give the reasons for your choices. (which can be seen on the drawings).
(Hare, Bear, Fox, Cat, Weasel, Caribou, Moose, Dog).

a 

This belongs to the _____ because

_____

_____

_____

b 

This belongs to the _____ because

_____

_____

_____

13. Which of the animals listed below would produce the following sets of tracks.
(Hare, Fox, House, Crow, Weasel, Bear).

a 

is the _____

b 

is the _____

14. A man going through the woods left the following set of tracks. What was he doing at each labelled point? (Walking, Standing, Hopping, Jumping, Running).

a. _____ b. _____

c. _____ d. _____

15. Which of the following pairs of animals changes the colour of their coats to white in winter?

a. Moose and Fox.
b. Lynx and Mink.
c. Hare and Lynx.
d. Hare and Weasel

16. Why would it be better for an animal if his coat colour changed to white in winter?

a. He is easier to see.
b. A white coat is warmer in winter.
c. He blends in with the snow colour.
d. His relatives can see him at night.

17. Some small animals are active in winter, but don't leave tracks as they live and feed in tunnels beneath the snow. Which of the following animals would this be true of?

a. Weasel (ermine).
b. Hare
c. Mink
d. Meadow Vole (field mouse).

18. Why is it that small animals have a better chance of surviving through winter beneath the snow?

a. Because it is darker beneath the snow.
b. Because all their food is beneath the snow.
c. Because they cannot walk over the snow surface.
d. Because it is warmer and safer from predators.

19. Some animals prepare for winter by growing fur on their feet, to act as snowshoes. Which of the following pairs of animals does this?

a. Moose and Hare.
b. Fox and Weasel
c. Lynx and Hare.
d. Lynx and Weasel

20. "Snowshoe" feet are different from "normal" feet in that

a. They are large and allow animals to collect snow.
b. They are used as snow shovels by animals.
c. They are smaller and make it easier for animals to walk over snow.
d. They are larger and make it easier for animals to walk over snow.

21. Which of these plants does not die during winter?

a. Dandelion
b. Moss
c. Crackerberry
d. Corn

22. Many trees prepare for winter by:-

a. Dying
b. Losing their leaves
c. Growing new branches
d. Producing flowers

23. Which of the following pairs of trees do not lose their leaves in winter?

a. Aspen and Birch
b. Fir and Tamarack
c. Birch and Spruce
d. Fir and Spruce

24. In an experiment three types of leaves (A, B, and C) were fixed by their leaf stalks and snow was added onto the leaf, until the leaf stalk snapped under the weight. The results were:

A - snapped under 4 ounces of snow
B - snapped under 21 ounces of snow
C - snapped under 10 ounces of snow.

Which of the leaves most likely belonged to an evergreen tree?

a) A b) B c) C d) None of them.

25. In another experiment leaves were tied in front of an electrical fan, and allowed to blow in the breeze. The leaves used were those of the spruce, birch and horse chestnut. Which one was blown least by the fan?

a. Spruce b. Birch c. Horse chestnut d. All of them

26. A bird which dies on the approach of winter must therefore survive as:-

a. Eggs
b. Buds
c. Flowers
d. Leaves

27. Which statement tells a way of deciding whether trees are alive in winter?

a. They have dead leaves on.
b. They have cones.
c. You can find buds on them.
d. They have green bark.

28. Which of the following trees does not grow during winter?

a. Fir
b. Pine
c. Birch
d. Spruce

29. Of what use are trees to animals in winter?

a. As shelter.
b. As food
c. As food and shelter
d. Of no use.

30 - 32

Read the following sentences (1-6) and then for the words listed below, select the sentence which best describes it.

Sentences.

1. What animals and plants possess which helps them to survive in their area.
2. The temperatures, amount of sun, snow and wind.
3. Moving from one area to another.
4. The amount of rain and snow.
5. All the things that surround an animal or plant i.e. climate, soil, air and other animals and plants.
6. What an animal or plant does when it dies?

Words.

30. ENVIRONMENT _____
31. CLIMATE _____
32. ADAPTATION _____

33. If an animal or plant (e.g. lion or palm tree), not adapted to our climate, was brought to Newfoundland, what do you think might happen to it and why?

34. If our winters were to become more severe, with colder temperatures, more wind and snow, what do you think might happen to our present winter active animals and plants, and why?

35. Name <u>one</u> winter active mammal or bird, and write down 2 ways in which it is adapted to a winter life.

36. Name <u>one</u> evergreen tree, and write down 2 ways in which it is adapted to a winter life.

2. AFFECTIVE TEST (ATTITUDE TO ENVIRONMENT)

	AGREE	UNSURE	DISAGREE
1. I like to watch and read programs about nature.			
2. The only use of plants is to cut them down and use their wood.			
3. Bad weather doesn't have any effect on wildlife.			
4. Mice are of no use to anybody.			
5. Trees are not alive.			
6. I always look for animal tracks and signs in the woods and garden.			
7. Destroying forests in order to build houses does not affect wildlife.			
8. Litter and empty bottles in forests is alright as it doesn't affect animals.			
9. Nature and man must exist together.			
10. Foxes and lynxes are dangerous and should be destroyed where possible.			
11. Forest fires are alright as long as they don't destroy people's homes or livelihood.			
12. Hunters should kill as many rabbits as they can.			
13. Ecology is an important subject which all people should learn about.			

3. TEACHER INTERVIEW SCHEDULE

1. IDENTIFICATION DATA

a. Teacher's Name b. Lesson # c. Topic

A. TEACHER'S GUIDE

(The questions in this section refer to the instructions etc. in the Teacher's Guide).

2. Sometimes the information describing a lesson was hastily written, and will have to be rewritten. Did you find the lessons easy to follow. Yes _____ No _____ If no please specify the part you had difficulty with and would like to see rewritten ?

3. Did you find the preparation for this lesson very time consuming? Yes _____ No _____ What in particular was time consuming (if anything)?

4. Was enough background information provided for this lesson (in the lesson in the lesson plan and the appendices)?
Yes _____ No _____
If no, what other information would you like to have seen provided?

5. Did you have any problems with the materials and/or equipment needed for this lesson?
Yes _____ No _____
If yes, what were the problems?

B. THE LESSON

(The questions in this section deal with the actual operation of the lesson).

6. I assume that often teachers will need to change these lessons to suit their own situations (i.e. make alterations, additions or deletions). Was the way you taught the lesson different from the lesson plan suggested in the module?

Yes _____ No _____

If yes, in what ways was your lesson different?

If yes, to what extent do you feel the changes were valuable?

7. How did you carry out the lesson?
(i.e. group activity, individual research, class discussion, library research, direct teaching, etc.).

8. How did you use the results the class had? (i.e. groups used own results, all results were placed on board, etc.).

C. OPINIONS OF LESSON
(The questions in this section ask how successful the actual lesson was).

9. Did students have any problems in carrying out the activity? Yes _____
No _____
Please specify problems if Yes, and what you feel accounted for these problems.

10. What indications did you have that the students achieved the objectives of the lesson?

11. What indications did you have that students enjoyed the activity?

12. How worthwhile did you find the activity overall?

D. OPTIONAL ACTIVITY

13. Did you make use of the optional activity (if there was one?) Yes _____ No _____
If Yes, how did you make use of it (i.e. as homework, an assignment, as a lesson, etc)?

4. COURSE OPINION QUESTIONNAIRE (STUDENT)

We would like to have your opinion of the course you have just completed. Could you please answer each of the questions below. Thank you very much for your help.

1. Did you
   a. like the course a lot _____
   b. like it a little _____
   c. dislike it slightly _____
   d. strongly dislike it _____

2. What did you like most about the course?

3. What did you dislike most about it?

4. Which lessons did you like the most?

5. Which lessons didn't you like?

6. What was the most worthwhile thing you learnt form the course?

7. Do you think all elementary school students should do the course? Why?

5. COURSE OPINION QUESTIONNAIRE (TEACHER)

During the teaching of the course your opinion on individual lessons was canvassed. Now we would like your views on the module as a whole. Could you please make comments in answer to the questions below. Thank you.

I. (a) To what extent were the problems (as stated at the beginning of each activity) appropriate ones, in terms of the material to be covered, the children's intellect and previous experience?

(b) How clear were these problems to the students at the beginning of each lesson?

2. (a) How appropriate were the objectives (stated at the beginning of each lesson) to the activities to be undergone, and were they reasonable in terms of the children's capabilities?

(b) How affectively did the objectives explain what was expected of the students in each lesson?

3. (a) How appropriate was the content covered to the grade level you taught?

(b) Was there sufficient material in each lesson to last the full length of a period? If some lessons were too long or short, please state the lesson numbers.

4. How adequate were the suggestions in the Teacher's Guide for carrying out the activities, in terms of details provided (i.e. too little, too much, or adequate)?

5. Many models, slides and pieces of equipment were included in the module. Do you feel that some were unnecessary or that more should have been provided? (please specify).

6. Perhaps some of the items covered are not necessary, especially where time is at a premium. Would you suggest that some could be excluded altogether, or left as optional activities?

7. Do you think that the out-of-class (optional) activities are important enough to be left in the module, and are of real value?

8. Do you feel that the sequence of the 14 lessons is logical, or would you like to see a change in their order? (please specify).

9. In view of teacher individuality and class variability, is it better to (a) not specify the number of lesson periods for each activity, but instead leave the activities as topics with teachers deciding on the time to be spent or (b) to specify the number of periods for each lesson as a guide to the time teachers should spend on each activity?

10. (a) To what extent is it necessary to read the whole of the teacher's guide before starting the module?

10. (b) Is the length of the guide adequate for other teachers who may not have contact with the developer of the module?

11. (a) To what extent does the exam succeed in testing the objectives of the course?

(b) How appropriate was the exam's reading level to the grade you taught?

(c) Are you satisfied with the types of questions on the exam?

12. How feasible is this module for the average Newfoundland elementary school teacher?

13. Do you think the module could be used with any grade levels other than 5 and 6?

14. What was your overall opinion of the course?

15. Do you think it fulfilled a real need?

16. Would you use it again?

17. If you would recommend this module to other teachers, what would be some of your reasons for doing so?

APPENDIX E

THE PERFORMANCE BEHAVIOURAL OBJECTIVES OF THE MODULE

LESSON 1

1. Given a choice of four sets of months, students will select "December, January, February and March" as the usual Newfoundland winter months.

2. Given a choice of four sets of temperatures, students will select "50, 60, 70°F" as the temperatures which would not occur in winter in Newfoundland.

3. Given a choice of four months, students will select "February" as the month most likely to have a temperature of -10°F.

LESSON 2

4. Given a choice of four months, students will select "December" as the month which has the shortest amount of sunlight.

5. Given a choice of four months, students will select "January" as the month most likely to have a total snowfall of 30".

6. When requested to do so, students will write a sentence which describes four important features of the Newfoundland winter climate.

LESSON 3

7. Given a choice of four items, students will select "growing a heavy coat of fur" as the way in which most mammals prepare for winter.

8. Given a choice of four items, students will select "migrate" as the thing which many birds do as winter approaches.

9. Given a choice of four animals, students will select "snowshoe hare" as the animal which does not hibernate.

10. When requested to do so, students will select from a list of eight animals, or use other examples, two which migrate, two which die, two which remain active in winter and two which hibernate.

LESSON 4

11. When requested to do so, and given that the presence of footprints is one such sign, students will list four other signs or traces of animal activity in an area.

LESSONS 5 AND 6

12. Given a choice of eight animals, students will select Moose and Fox as the animals which would make the prints (a) and (b), and will write down two reasons for each of their choices.

13. Given a choice of six animals' track patterns, students will select "Hare and crow" as the animals which would produce tracks (a) and (b).

LESSON 7

14. Given a choice of five sets of actions, students will select "standing, walking, running and jumping" at points (a), (b), (c) and (d) respectively, as the actions the man was performing as he was going through the woods and left the set of tracks.

LESSONS 8 AND 9

15. Given a choice of four pairs of animals, students will select "Hare and Weasel" as the pair of animals which changes the colour of their coats to white in winter.

16. Given a choice of four items, students will select "He blends in with the snow colour" as the reason why it would be better for an animal if his coat colour changed to white in winter.

17. Given a choice of four animals, students will select "meadow vole" as an example of a small animal which is active in winter, but doesn't leave tracks as they live and feed in tunnels beneath the snow.

18. Given a choice of four items, students will select "because it is warmer and safer from predators" as the reason why small mammals have a better chance of surviving through winter beneath the snow.

19. Given a choice of four pairs of animals, students will select "Lynx and hare" as the pair of animals which prepares for winter by growing fur on their feet to act as snowshoes.

20. Given a choice of four items, students will select "They are larger and make it easier for animals to walk over snow" as the way in which "snowshoe" feet are different from "normal" feet.

LESSONS 10 AND 11

21. Given a choice of four plants, students will select "moss" as the

plant which does not die during winter.

22. Given a choice of four sets of items, students will select "Losing their leaves" as the way in which many trees prepare for winter.

23. Given a choice of four pairs of trees, students will select "Fir and spruce" as the pair of trees which does not lose their leaves in winter.

LESSON 12.

24. Given the results of an experiment in which three types of leaves (A, B and C) were fixed by their leaf stalks and snow was added onto the leaf until the leaf stalk snapped under the weight, students will select "B" as the leaf which most likely belonged to a spruce tree.

25. Given another experiment in which leaves were tied in front of an electrical fan and allowed to blow in the breeze, students will select "Birch" as the leaf blown least by the fan.

LESSON 13.

26. Given a choice of four items, students will select "Seeds" as the way a plant, which dies on the approach of winter, must survive.

27. Given a choice of four statements, students will select "You can find buds on them" as the statement which tells a way of deciding whether trees are alive in winter.

28. Given a choice of four trees, students will select "Birch" as the tree which does not grow during winter.

29. Given a choice of four items, students will select "Food and shelter" as the use which trees are to animals in winter.

LESSON 14.

30.

32. Given a choice of six sentences, students will select the sentences 5, 2 and 1 as those best describing the words environment, climate and adaptation.

33. When requested to do so, students will write a sentence which adequately explains what would happen to an animal or plant, not adapted to our climate, if brought to Newfoundland, and why.

34. When requested to do so, students will write a sentence which adequately explains what would happen to our present winter active animals and plants if our winters were to become more severe, with colder temperatures, more wind and snow, and why.

OTHERS

35. When requested to do so, students will name one winter active mammal or bird, and write down how it is adapted to a winter life.

36. When requested to do so, students will name one evergreen tree, and write down how it is adapted to a winter life.